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The Green Thumb



Spring 1980

Vol. Thirty-seven
Number One

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The Cover

Primrose—Harbinger of Spring

The Green Thumb

Spring 1980

Vol. Thirty-seven, Number One

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1980 Denver Botanic Gardens, Inc.

William H. Anderson, Jr., Ed.D.
Gilberta T. Anderson
editors

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Denver Botanic Gardens, Inc. maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

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Berry Lovers, Grow Your Own

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Vern LaCrosse

How long has it been since you saw fresh raspberries, currants, gooseberries, blackberries, or elderberries for sale in your local supermarket? Have you ever seen golden raspberries, mulberries, dewberries, bush cherries, or serviceberries for sale? We do find table grapes, strawberries, and blueberries, but at high prices and of widely varying qualities. Some berries are considered to be too labor intensive as a crop for mass marketing, and too fragile for shipping in proper ripened condition. While new harvesting machines are being developed for certain berry plants, the availability of these delectable fruits will probably be limited for years to come. If you're a berry lover, the solution is to grow your own; the purpose of this article is to encourage just that.

Never in our nation's history has there been the interest in berries, fruits, and nuts that is apparent throughout our country today. Exciting new varieties or variety

Mr. LaCrosse is a Colorado State University Master Gardener. His article written about his Golden, Colorado garden tells about Denver altitude growing of small fruits. An article in the Summer 1977 issue of *The Green Thumb* told of High Altitude gardening.

improvements are almost continually being introduced, and the better growers sell out their newer or finer stock quickly each season. The "tissue culture" technique of plant propagation is now being applied to berry plants in our country with the bright promise of making more plants in greater varieties, and of higher quality, with lower costs, available to all. Fruit scientists at the USDA Fruit Laboratory in Beltsville, Maryland have produced 3,000 rooted strawberry plants from one meristem! Clearly, we have the opportunity to grow and enjoy a wide assortment of berries in our own gardens with outstanding successes and premium quality.

Now come all the negatives. "You can't grow most berries or small fruits in Colorado because: we range from agricultural zone 5 to zone 3; we have late snows and frosts; we have wind, hail, poor soil, low humidity, little rain, air pollution, diseases, and bugs." We do indeed have all of the above conditions in varying degrees, but the truth is that you can grow virtually anything in Colorado, if you want to badly enough! So, let us ignore the negatives we hear, and consider the berries and growing methods for outdoor plantings that we can enjoy.

Planning your berry patch should begin with some reading; the sources for detailed information include the excellent library at the Denver Botanic Gardens, the County Extension Offices of Colorado State University (numerous state and federal publications either free or at nominal cost), garden clubs, any public library, garden magazines, growers' catalogs, local nurserymen, plus short articles presented by the newspapers. I prefer books published by the Rodale Press, Garden Way Publishing, and the articles regularly appearing in *Organic Gardening Magazine*. If you wish to grow berries commercially, subscribe to the *Western Fruit Grower Magazine*.

Buy Only Healthy Plants

Ordering your plants can be exciting as you leaf through the many splendid catalogs trying to select offerings best suited to you and your outdoor growing conditions; it's mighty easy to get carried away. Do not, ever, accept strawberry or bramble plants such as raspberry and blackberry from an amateur grower at any price — the disease risk is just too high. Buy only from a reliable source that clearly states "Virus Free" in describing strawberry offerings: this is the most important advice I could give you as strawberries are prone to disease problems. Try to buy your brambles also from a grower offering "Virus Free" plants. The many other delicious berries you might want are not yet commonly available in "certified", "registered", or "Virus Free" stock designations, but work is progressing in those directions. Best advice — buy the finest stock you can find, northern grown,

with specific variety names, and with a written warranty. Berries are best purchased during the winter and planted in the spring



Strawberry

as a better selection is available, and planting risks are minimized. Here are my favorite berry plant sources: Bountiful Ridge, Burpee, Emlongs, Guernsey, Kelly Brothers, Miller Nurseries, Rice, and The New York State Fruit Testing Cooperative Association. This last source is simply fantastic if you are interested in experimental and advanced species.

Choose Sites Carefully

Your planting sites should be open and sunny, with good air circulation and water drainage. Avoid "hot spots", such as a white-painted south-facing wall. Currants and gooseberries will tolerate some shade. Use berries as landscaping plants and get foliage, flowers, and fruit. Plants can be grown in raised beds, containers, hedges, cluster plantings, borders, backgrounds, as row crops, or as a feature planting, depending upon the planting site and use, variety, your needs, and your imagination. Good deep soil is desirable, but you can greatly improve soils by adding any form of organic material. Peat moss, rotted manures, compost, organic mulch, and sawdust are

among the best soil additives to build and enrich the earth to produce fine crops. Use grass clippings (free of poison sprays) and leaves to mulch your plants; this invites earthworms, keeps soils from drying, holds down weeds, and keeps the fruits cleaner. With organic methods there should be no need for chemicals in any form, for any purpose. Remember, strong healthy plants resist disease and insects best. The pH (acid-alkali ratio) requirements vary some among berries. However, you will find that in soils rich in organic matter this factor is less critical. Prepare each planting site carefully; dig a "\$5.00 hole for a \$1.00 plant."

Most growers provide you with planting and growing tips when you purchase plants — these instructions and suggestions are usually easy to follow and quite good. Pollination is not commonly a problem among berries as they are mostly self-fruitful. Bees and certain other little creatures help to pollinate within a plant or planting. Our dry climate requires extra attention to new plantings, especially strawberries. Container-grown plants need the most attention, particularly during very hot weather. Keep the grass and weeds away from the plants, especially in their first year. Dormant oil spray should be used early in the spring on berry bushes, canes, and vines, just as you treat your trees. This product is natural, readily available, easy to use, and works wonders.

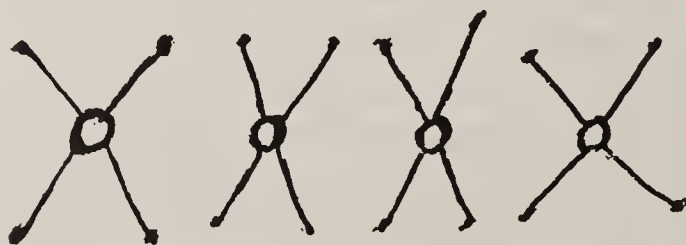
Colorado-Hardy Plants

Here are some suggestions for specific berries that have done well in Colorado and surrounding states. Altitude and micro climates must be considered. Note that only a few varieties are listed; you are encouraged to try other varieties that appear suited to this region.

Strawberries

These are the most widely grown berry, tolerate most soils, grow at elevations to 10,000 feet, have countless varieties with early, mid-season or late season ripening, plus everbearing varieties.

The planting technique for home gardens is usually the spaced matted-row system, wherein you plant about 18" apart in rows spaced 14" to 36" apart. Allow four runners to grow and root equally spaced from each plant. Pick off all (or most) blossoms the first year to permit a strong plant and runner-plant system for next year. Mulch and water carefully. The next year will produce an excellent crop; the third year will be less abundant, the fourth year still

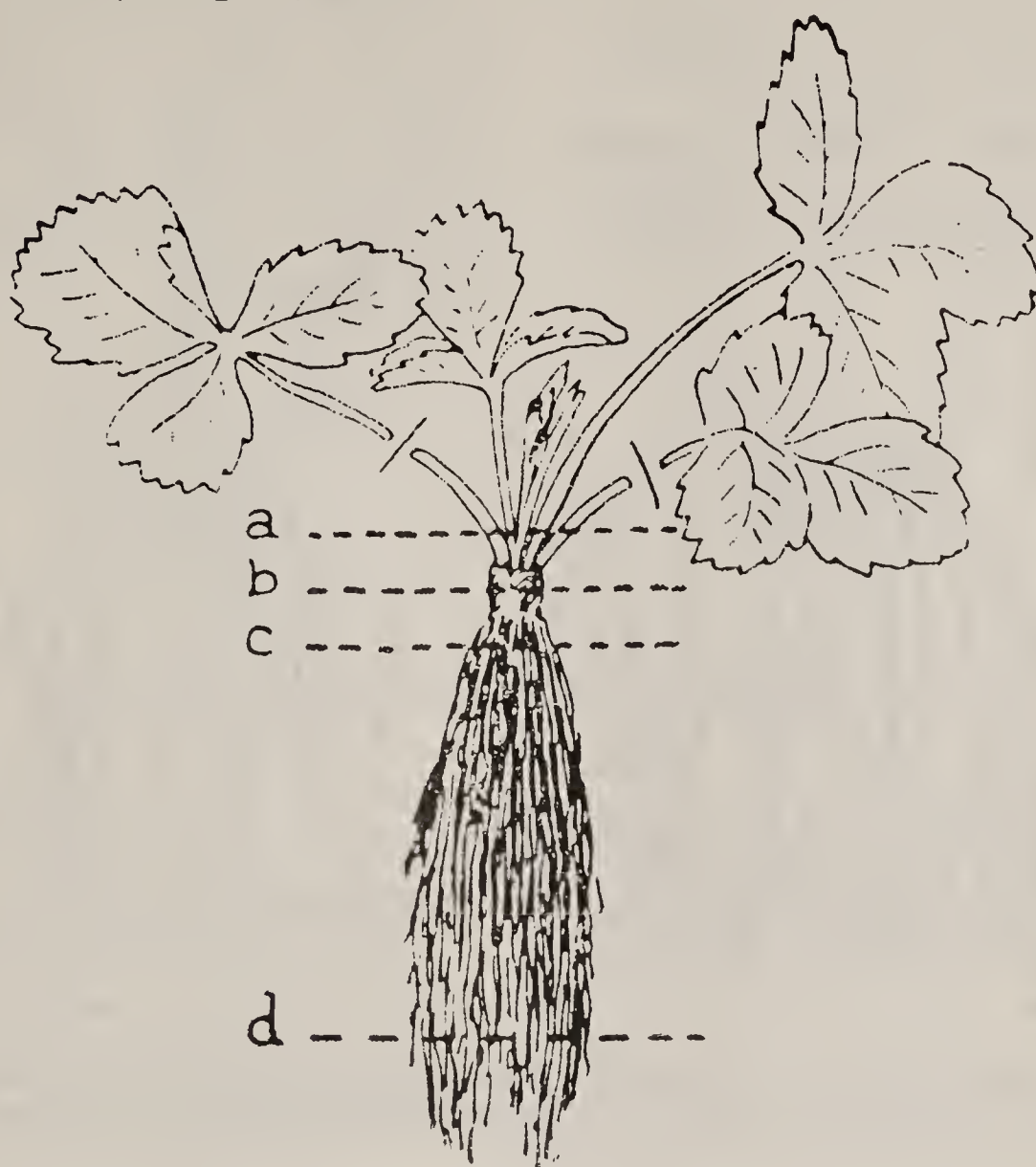


A Well-spaced Matted Row System

less. Plan to turn the planting under after the third or fourth year, having planted new areas to replace this bed. If you maintain an old bed, you must remove the original or older plants each year as they produce poorly. The

professionals maintain production rates to several tons per acre through hi-density plantings and crop rotation. Suggested are: Early season — Cyclone, Fairfax; Mid-season — Catskill, Empire; Late

season — Sparkle, Vesper; Everbearing — Ogallala, Ozark Beauty, Ft. Laramie (extra hearty). Watch for a new one called Holiday.



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A strawberry plant showing trimming and depth of planting. a, Planted too deep; b, planted correct depth; c, planted too shallow; d, pruning of roots.

Raspberries and Blackberries

Clean, dead ripe, fresh picked, home grown raspberries soaked in fresh cream are awfully hard to beat, unless maybe you add them to homemade ice cream! Grow all these berries in full sun in good, deep, well drained soil. Use plenty of mulch; space plants $2\frac{1}{2}$ to $3\frac{1}{2}$ feet apart; keep the weeds away, and cultivate lightly; insist on "virus free" stock. These berries need some support, either from stakes or trellis wires; most are quite hardy. Pruning techniques are dictated by the variety you

grow. One-crop red raspberries produce on last year's new shoots, so prune the woody, brown canes in the fall, leaving about 4 good healthy canes per square foot of row, and top back to 3 - 4 feet in height. Everbearing (really 2 crop) varieties bear on last year's new growth, then bear in September on this year's new growth. So — prune out the last year's canes (brown and woody appearing) in the fall or after the July fruiting is complete. Control the new shoot growth by pulling or transplanting to maintain the plant density of four plants per square foot. Black

and purple raspberries, also blackberries grow long canes which touch the ground to form new plants by layering. These plants bear in mid-summer from last year's new growth. Keep these plants well pruned and prevent a bramble patch. Burn all pruned canes. For red raspberries, I suggest Lathan, Taylor, or Hilton; Heritage for a two-crop red. For blackberries, try Bristol or Allen.

For a purple raspberry, try Brandywine or Clyde. And the best I've saved for last: Fall-Gold yellow raspberries are the sweetest, prettiest, and on and on — please try this one, if it's the only plant you own! It is hardy to 25° - 30° below, fruits continuously from July to late October, is easy to grow, and obviously my favorite berry. Other blackberry varieties that grow well here are Darrow and Thornfree.

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(left) Red raspberry canes before thinning or pruning in April; (right) after thinning. Spaced 4 to 8 inches apart and 3 to 4 canes per running foot of row.

Currants and Gooseberries

These are old time favorites, especially in England and Europe. They grow well from middle to high altitudes with no restrictions by U.S. Forest Service. They are simple to grow and propagate and are very productive but not commonly for sale in markets at any price. Jellies and pies made from them are rare delicacies. Plant in hedge or rows spaced 3 - 4 feet apart. These berries tolerate poor soil but produce amazing crops on good soil; some growers feel that both currants and gooseberries like a bit of shade

rather than constant sun. Choose Poorman or Colossal for sweetest red gooseberries and Pixwell for a lighter pink variety. Do not buy black currants. Choose Wilder or Perfection for fine flavor, bright red fruit, and good yield. Cut out only 3 year old canes when pruning.

Blueberries

Incredibly expensive at the stores with many exciting and prolific new varieties, blueberries are simply terrific, but they grow

poorly here in Colorado. You can grow blueberries best by using containers, as the pH requirement

is between 4 - 5.5. The culture of blueberries is frankly difficult in our area, but not impossible.



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A currant bush (A) before and (B) after being pruned.

Elderberries

This plant grows something like a lilac bush and needs some thinning or sucker removal each year. This beautiful species is ornamental, easy to grow, is great for jelly, and I'll swap a 1972 "Cab.-Sav." for a bottle of Elderberry Wine. Choose the very superior Adams, Nova, or York Varieties.

If you are a berry grower, I truly hope you're now thinking of spots for some plants you've not yet tried; if you are a berry lover and not a grower, please join us growers, and share the many joys that berries freely give.

Miscellaneous Small Fruits

Many other small fruits grow well here, particularly the native berries. These can be decorative and ornamental, used as windbreakers, handsome flowering trees, hedges, or just as birdfood. If you are a berry lover and serious gardener, by all means study, grow, and enjoy these less common plants. Some suggestions: boysenberry, loganberry, dewberry, bush cherries, mulberry, wild plum, chokecherry, juneberry, buffaloberry, and serviceberry.



Raspberry Bush

A Select List Of Shrubs

TALL SHRUBS, Generally 6 ft. and above

E. Alan Rollinger
Bernice E. Petersen

8 (Editors' Note:) This chart is an adaptation of one more general in scope published in *The Green Thumb* in March 1952, Vol. 9, No. 3, when George W. Kelly was editor. It has been brought up-to-date by E. Alan Rollinger, Landscape Architect, with the assistance of Mrs. Bernice E. Petersen. The shrubs listed are commercially available and generally hardy in the Denver area and in other parts of the state of a similar altitude and climate. It is based largely upon Mr. Rollinger's experience, using the 1952 list as a foundation.

		BLOOM		FRUIT		GOOD FALL COLOR	GOOD WINTER EFFECT
		COLOR	SEASON	COLOR	SEASON		
<i>Acer ginnala</i>	Amur Maple					X	
<i>A. glabrum</i>	*Rocky Mtn. Maple					X	
<i>A. grandidentatum</i>	Big Tooth Maple					X	
<i>Alnus tenuifolia</i>	*Thinleaf or						
	Mtn. Alder	p	Ap	br	Se		X
<i>Amelanchier</i> sp.	Serviceberry	w	Ma	b	Jl		
<i>Aralia spinosa</i>	Devils Walking-						
	stick	w	Ap	b	Ag		
<i>Betula fontinalis</i>	*Rocky Mtn. or						
	Water Birch			br	Se		X
<i>Buddleia</i> sp.	Butterflybush	v	Ag				
<i>B. alternifolia</i>	Hardy Butterfly-						
	bush	v	Ma-Jn				
<i>Caragana arborescens</i>	Siberian Peashrub	y	Ap	w	Ag		
<i>Cercis canadensis</i>	Eastern Redbud	m	Ma				X
<i>Cercocarpus montanus</i>	*Mountain						
	Mahogany			w	Se		X
<i>C. ledifolius</i>	*Curlleaf						
	Mahogany			w	Se		X
<i>Chaenomeles speciosa</i>	Flowering Quince	p-r	Ma				
<i>Colutea arborescens</i>	Bladder-senna	y	Ma	w	Se		X
<i>Cornus alba</i> 'Variegata'	Variegated						
	Dogwood						X

<i>C. mas</i>	Cornelian Cherry	y	Mr	r	Se	X	
<i>C. sericea</i>	*Redtwig Dogwood	w	Ma	w	Ag	X	X
<i>C.s. 'Flaviramea'</i>	Yellow-twig Golden-twig Dogwood	w	Ma	w	Ag		X
<i>Cotoneaster acutifolius</i>	Peking Cotoneaster	p	Ma	b	Se	X	
<i>C. multiflorus</i>	Lg. Flwg. Coton- easter	p	Ma	r	Se	X	X
<i>C. soongoricus</i>		p	Ma	r	Se	X	X
<i>Crataegus crusgalli</i>	Cockspur Hawthorn	w	Ma	r	Se	X	X
<i>C. mollis</i>	Downy Hawthorn	w	Ma	r	Ag	X	X
<i>C. phaenopyrum</i>	Washington Hawthorn	w	Ma	r	Se	X	X
<i>Elaeagnus angustifolia</i>	Russian Olive	y	Je	w	Se		X
<i>E. umbellata</i>	Autumn Olive	y	Je	w	Se		X
<i>Euonymus alata</i>	Winged Euonymus					X	X
<i>E. europeaa</i>	European Euonymus			p	Se	X	X
<i>Forestiera neo- mexicana.</i>	*N. Mex. Privet	y	Ma	b	Ag		
<i>Forsythia x intermedia</i>	Forsythia	y	Ap				
<i>Hibiscus syriacus</i>	Shrub Althea	v	Ag				
<i>Hippophae rhamnoides</i>	Seabuckthorn			o	Se		
<i>Kolkwitzia amabilis</i>	Beautybush	p	Ma				
<i>Ligustrum obtusi- folium regelianum</i>	Regels Border Privet	w	Je	b	Se		
<i>L. vulgare</i>	European Privet	w	Je	b	Se		
<i>L. x vicaryi</i>	Golden Vicary	w	Je				
<i>Lonicera korolkowii</i>	Blueleaf Honey- suckle	p	Ma	r	Ag		
<i>L. k. zabelii</i>	Zabel's Honey- suckle	r	Ma	r	Jl		
<i>L. tatarica</i>	Tatarian Honey- suckle	p	Ma	r	Jl		
<i>Mahonia aquifolium</i>	Oregon Grape	y	Ap	b	Se		X
<i>Philadelphus coro- narius</i>	Mockorange	w	Je				
<i>Physocarpus opuli- folius</i>	Common Ninebark	w	Je				X
<i>P. o. 'Luteus'</i>	Golden Ninebark	w	Je				X
<i>Prunus americana</i>	*Wild Plum	w	Apr				
<i>P. x cistena</i>	Purple Leaf Plum	p	Ma				
<i>P. pensylvanica</i>	Pin or Bird						
<i>saximontana</i>	Cherry	w	Ma	r	Ag		
<i>P. tomentosa</i>	Nanking Cherry	w	Ap	r	Jl		
<i>P. virginiana</i>							
<i>melanocarpa</i>	*Western Choke- cherry	w	Ma	b	Ag		
<i>Ptelea trifoliata</i>	Water Ash, Hoptree			w	Se		
<i>Rhamnus cathartica</i>	Common Buck- thorn			b	Se		

	<i>R. frangula</i>	Glossy Buckthorn				b	Se		
	<i>R. F. 'Columnaris'</i>	Tallhedge Buckthorn				b	Se		
	<i>R. smithii</i>	*Smith's Buckthorn				b	Se		
	<i>Rhus glabra</i>	Smooth Sumac	y	Ma		r	Se	X	X
	<i>R. typhina</i> 'Dissecta'	Cutleaf Sumac	y	Ma				X	
	<i>Robinia neomexicana</i>	*New Mexican Locust	w-p	Ma					
	<i>Rosa</i> sp.	Shrub Rose		Jn					X
	<i>Salix irrorata</i>	*Bluestem Willow	w	Ap					X
	<i>S. monticola</i>	*Yellow Mtn. Willow	w	Ap					X
10	<i>Sambucus canadensis</i>	Green Elder	w	Jl					
	<i>S. c. 'Aurea'</i>	Golden Elder	w	Jl	b	Ag			
	<i>S. c. 'Acutiloba'</i>	Cutleaf Elder	w	Jl					
	<i>Shepherdia argentea</i>	*Buffalo Berry	y	Ap	o	Jl			
	<i>Spiraea vanhouttei</i>	Vanhoutte Spirea	w	Ma				X	X
	<i>Spiraea x arguta</i>	Garland Spirea	w	Ma					
	<i>S. prunifolia</i>	Bridalwreath Spirea	w	Ma				X	
	<i>Syringa</i> sp.	Lilacs, French, Persian, Canadian							
	<i>Tamarix hispida</i>	Kashgar Tamarisk	p	Jl				X	
	<i>Viburnum x carlcephalum</i>	Fragrant Snowball	p	Ma				X	
	<i>V. dentatum</i>	Arrowwood	w	Ma	b	Se		X	
	<i>V. lantana</i>	Wayfaring Tree	w	Ma	y-r-b	Se		X	X
	<i>V. lentago</i>	Nannyberry	w	Ma	b	Se		X	X
	<i>V. opulus sterile</i>	Snowball	w	Ma					
	<i>V. trilobum</i>	Am. Cranberry-bush	w	Ma	r	Se		X	X

* - Native b - blue, black br - brown m - magenta o - orange
p - pink r - red v - violet w - white y - yellow

Mr. Rollinger, practicing landscape designer-consultant, currently teaches home landscaping at Denver Botanic Gardens. He teaches Plant Materials and Planting Design at Colorado State University. With Dr. James Feucht he is co-author of "Trail of Trees," and he assisted George Kelly in the booklet "Good Gardens with Less Water." He has written previously for *The Green Thumb*.

Mrs. Bernice E. Petersen is the Honorary Editor of *The Green Thumb*, has edited the magazine and written many articles for it. She is also a knowledgeable home gardener.



Antipodal Plants Are Astounding

Jane Silverstein Ries

Having no expertise as have our botanist, Dr. Moras Shubert and our horticulturist, Andrew Pierce, I can give only my impressions of The Denver Botanic Gardens South Pacific Tour on Nov. 3-27, even though I have piles of notes on over 350 plants to decipher the Maori and botanical names.

I enthusiastically report that New Zealand is the most beautiful country I have ever seen. South Africa is a close second. The cleanliness delighted me — no air or water pollution — with a population of 3½ million, no people pollution yet (though having 500,000 tourists a year may change this), no billboards, no tipping.

Now to some of the highlights.

November 4 — Rarotonga, A Gem, in the Cook Islands

On arrival at Rarotonga, I gladly gave up my pin vase of Denver flowers for a welcoming knee length lei of pink, heavenly scented frangipani (*Plumeria*).

We toured the 20 mile perimeter of the island seeing crops of taro, breadfruit, mango, papaya, guava, citrus, avocado, passion fruit,

Mrs. Jane Silverstein Ries is a Fellow of the American Society of Landscape Architects. She has written other articles for this magazine.

allspice, coconut and date palms, manioc (tapioca), watermelon, and unusual beans 24 inches by ¼ inches — real string beans. 11
Doesn't that make your mouth water? We had all these fruits for breakfasts and pineapple too, though we didn't see that growing.

November 5

A Maori gave us a demonstration of how the people serve coconut: He used a piece of coral to break the coconut and removed the outer shell with a pointed rod stuck into the ground. He sat on a small stool which had a serrated iron knife attached to shred the meat. He picked ten large leaves of the tree hibiscus and wove them into a platter, scattered the coconut meat on this, and gave us each an orange to suck out the juice while helping ourselves to the shredded coconut. Delicious!

Lovely "Tara Maori" worn for special occasions by men and women are tiaras, 8 inches high, made of the native single gardenia interwoven with mint leaves. These last for three days.

We reluctantly left this sub-tropical flora of royal poinciana, oleander, bougainvillea, croton, hibiscus, ti, orchids, kalanchoe, ginger, ficus, giant rubber trees of 8 foot caliper, cassia (similar to laburnum), ferns, palms, bird of

paradise, even a native *gaillardia* very like our own *Gaillardia pulchella* Foug. There were 15 to 20 species of tree ferns and bracken, orchid tree (*Bauhinia*), palm trunk or totem coconut which the natives carve, *Agapanthys* (Blue Lily of the Nile) and *Centranthus ruber* DC. (red valerian).

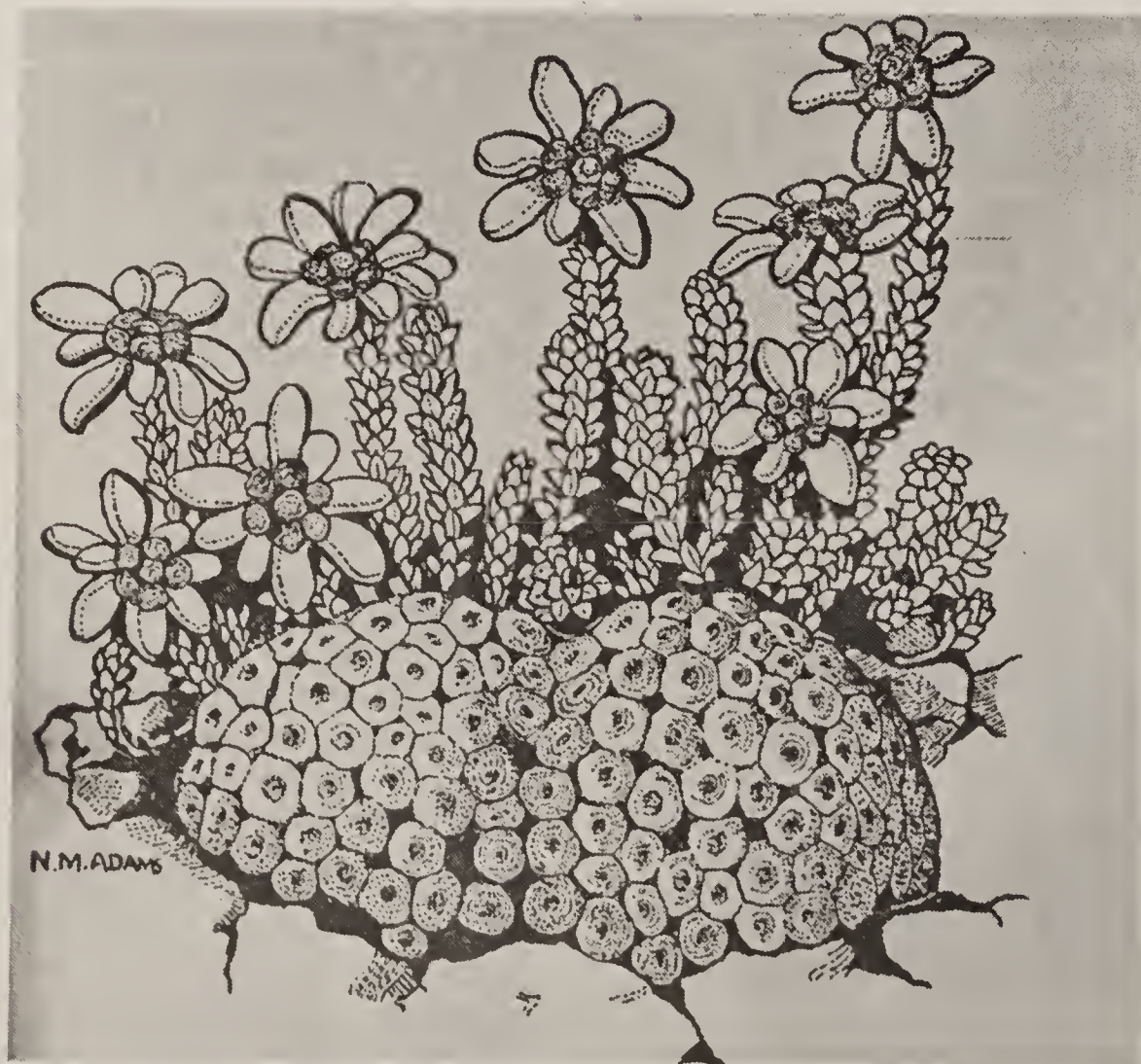
12 From these shores, in 1350, because the island was too populated, it is believed that 25 canoes of Maoris left to find another island. Seven canoes made it to the "Land of the Long White Cloud", New Zealand's north island. We followed 649 years later by air.

November 7 — (We lost a day over the International Date Line) — Auckland, pronounced "Oak-land"

November 8 — Eden Gardens

Started in 1964 in an old quarry of granite, basalt, and tuffscoria, 7 acres were made beautiful and entirely maintained by volunteers, three women and seven men pensioners.

Magnolia seiboldii C. Kuch, a very unusual single white flower with a red center, azaleas, rhododendrons, camellias, true purple beech or *Fagus*, Rimu red pine, Japanese maple, a gorgeous electric blue ground cover of *Lithospermum* (maybe we could try this in Colorado) were everywhere. New Zealand flax, *Phormium tenax* J. R. & G. Forst. of many forms, a plant that looks like a yucca, grows from 3 feet to 6 feet high with a 6 foot spread and was used by the early Maoris for weaving mats and textiles. It is still so used today. Nasturtiums are used as a



**Vegetable Sheep — *Raullia* and *Haastia*
— with Edelweiss**

ground cover to hold steep slopes. *Dicentra spectabilis* 'Alba', a white bleeding heart, three types of tree ferns, *Protea*, conifers, nikau palm, and cabbage trees (*Cordyline*, members of the Liliaceae, which look like *Yucca* at the tops of tall trunks) comprised the forest.

Centennial Memorial Park Nature Reserve

Here we found the famous kauri tree, the native which was used by early Europeans for ship masts as it grows to 100 feet. It has ball and socket type branches up to 40 feet and has no knots. We saw a 450 year old specimen of 10 foot caliper. The forests were almost denuded but more are being planted now. Here too were *Podocarpus*, red, black, or white pine in many varieties with foliage like yew. The Rimu or red pine grows to 170 feet tall and bush lawyer is a *Rubus* or bramble to "keep you in order."

Auckland Regional Botanic Gardens is 200 acres big and under construction. The area has 3 months of drought a year during which the grass turns brown. Here we saw fantastic pink, white, and yellow marguerites which were almost shrubs with a 3 to 4 foot spread.

Nearby we went to a tidy small nursery run by a man and his wife. They get 300 customers on weekends. They sell "spent mushroom" soil, and believe it or not, an 8" Koster Blue Spruce in a gallon can for \$31.50! These are hard to propagate and must come from Christ Church on the South Island.

November 9 — Our trip continued on to Taupo along the Waikato (Water/River), the longest

in New Zealand. It is stocked with rainbow and brown trout. We traveled through marvelous grasslands over miles and miles of rolling hills of green pastures with thousands of sheep and lambs sprinkled over them which made us excitingly aware of the beauty of this land. New Zealand has 57 million sheep and I think we saw all of them on the two islands!

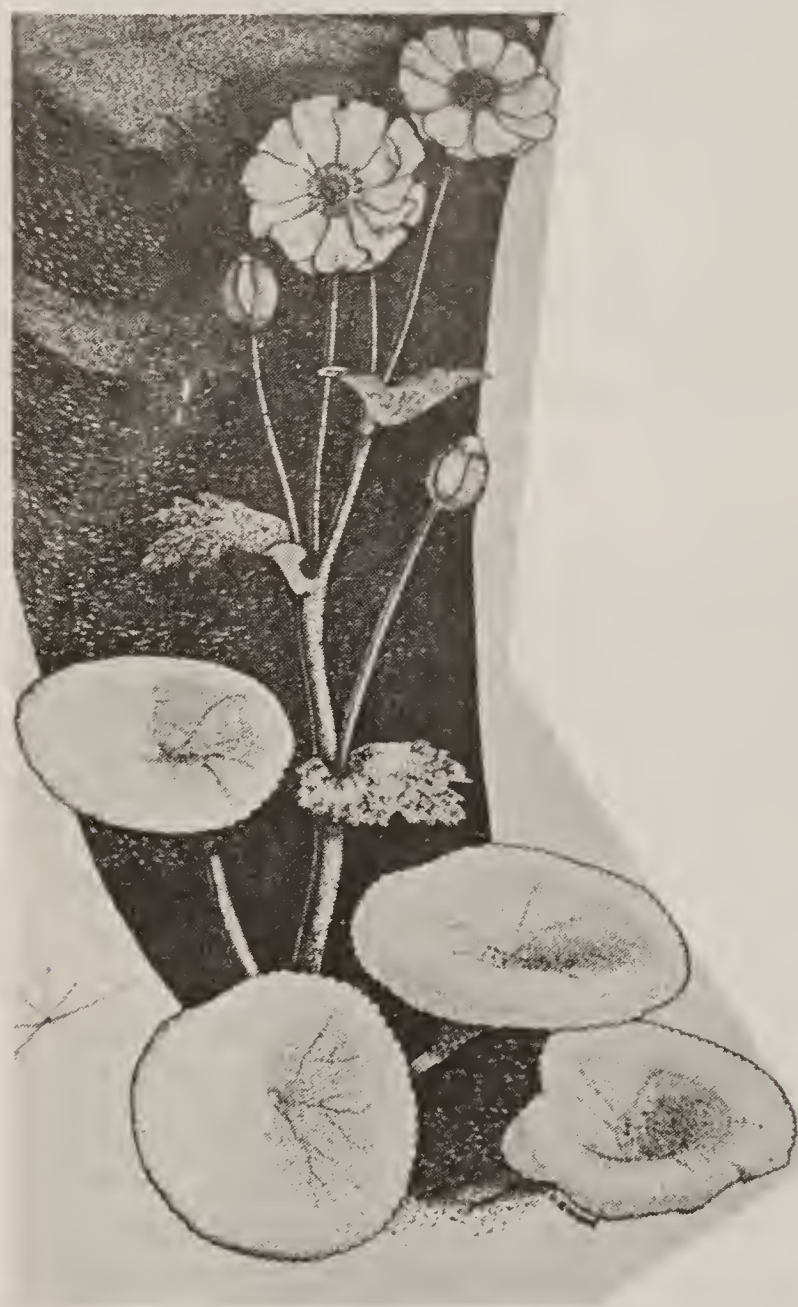
All these pasture lands previously had been covered with the native 13 "bush" made up of podocarps, conifers, cedars, rata pines which had been cleared — a remarkable accomplishment in the days of only horse power! The properties had windbreaks of pines and cedars sheared to a height of 30 feet and as wide, with hedgerows of barberry 8 feet wide and high, and also hawthorn hedges. The hilly grasslands are fertilized by helicopters and DC-3 planes which can carry 5 tons.

There were quantities of gorse and broom, lovely yellow patches which have become invasive and hard to eradicate. We saw miles of yellow lupine and at an Agrodome saw 17 different breeds of rams with magnificent horns, each on his own pedestal. At a shearing demonstration we heard of a champion who has sheared 650 sheep in 9 hours. Among trained working dogs, worth \$500 each, there is a type called "Eye" sheep dog; he does not bark and can keep sheep in one place for hours by just staring at them! We saw one doing that!

At Rainbow Springs there were a hundred species of ferns and redwood trees 80 feet tall and 5 foot caliper which were only 53 years old. Things grow like mad! Here we saw a live Kiwi, the New

Zealand national bird. This prehistoric, flightless, nocturnal bird survived because New Zealand had no predators. Its long beak has nostrils at the tip and it pokes into the soil for grubs. The only sound it makes is when it blows out the soil from its nostrils. The female lays one egg at a time, one fourth her size, and then the male sits on it for 75 days. That's Women's Lib!

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Ranunculus lyallii

Rotorua

At Rotorua we saw the thermal steam vents and mud pools. There we attended a very interesting Maori ceremonial performance and learned the meaning of the stuck out tongue of the Tiki carvings!

State Forestry Areas were newly planted forests of *Pinus radiata* D. Don and *P. aristata* Engelm. and Douglas-firs for lumber and paper pulp. Rows were planted vertically on the hills rather than following contours.

November 10 — Waipahihi Reserve — Taupo and Large Lake Taupo

Here there were hebes in great profusion, related to *Veronica*, growing from ground covers to 10 foot trees. We saw so many, we decided we had the "Hebe Jeebees". The highlight of this day was seeing a group of *Myosotidium hortensia* Baill. — Chatham Island forget-me-not — bright blue flowers with shiny large round leaves the size of dinner plates. There were fantastic rhododendrons 20 feet high and as wide in pink, red, and white and azaleas yellow and orange, hostas of many varieties, and ferns, ferns, ferns, the most prolific in the world. The silver fern, the underside of which is shiny at night, is a symbol of New Zealand. The tree fern, *Dicksonia squarrosa* Swartz., up to 80 feet tall, is used for retaining walls and fences. There were *Ceanothus*, a blue flowered shrub, arum lilies, toe toe, a New Zealand pampas grass, and yellow and white foxgloves.

November 11 — at New Plymouth

This was the center of rich dairy farms with plenty of "Mooloos" (cows). The Land and Surveys Department owns 75% of the farmlands.

From our hotel we had a spectacular view of symmetrical Mount Egmont, 8260 feet, with its "Long White Cloud" of Maori legend.

November 12 — Tupare means a cliff or a garland of flowers.

A private garden of 8½ acres on steep banks was in 1932 covered with blackberry, gorse, and bracken. It is now planted with fruit trees. Here a *Rhododendron giganteum* Forr. et Tagg. attains 86 feet. There are beeches and hundreds of other trees, shrubs, and flowers. The most interesting was the *Davidia involucrata* Baill., the ghost, dover or handkerchief tree, the white petals of which are really bracts that flutter in the wind.

November 13 — Pukekura Park and Brookland Park

We walked through fern tunnels, cut out onto the hillsides, to see 60 kinds of orchids, fuchsias, begonias. In the park there were a copper beech which was 105 years old, a huge Monterey cypress, and white and red horse chestnuts. The unbelievable, large mix of plants in this hemisphere is due to volcanic soil, good drainage, equable temperature, and rainfall evenly distributed throughout the year.

November 14 — Palmerston North

The Dugald Mackenzie Rose Garden was the most outstanding, well-designed rose garden I have ever seen. It bears 350 varieties of roses on 5 acres with large grass panels between rectangular beds, radiating from a raised central viewing platform with a backdrop of large trees. The partial pergola (no horizontal top) was in good scale and an effective approach to 15 the viewing area. The pillars are placed far apart for an excellent display of climbing varieties.

Windy Wellington, the capital, had a very handsome new parliament building which looked like a beehive. It rained the whole time we were there; 104" a year rainfall is normal.

Before leaving the North Island, I must comment on the Maori natives we met. Our delightful tour drivers, one for the north and one for the south, called "Steerologists", gave us valuable information of their culture. Their art in carving and weaving has a uniquely attractive design. The men do the carving, the women the weaving. Their ability as voyagers in canoes was a marvel. They are accepted into the economy and society very well. Their influence on New Zealand is reflected in their names of mountains and waterways and above all, in the names of their plants and birds.

November 15 — South Island: Christ Church Botanical Gardens

Along the Avon River there were tremendous copper beeches, some

cut leaf beeches 60 years old, lindens, oaks, cedars, yellow leaf linden and a *Malus trilobata* C. K. Schneider which we might try in Colorado. There were variegated elms, laburnum, and large tulip trees (*Liriodendron*).

16 **November 16** — Christ Church is a beautiful city and very British. In the town octagon, I purchased from a flower cart for 30¢ nine stalks of the beautiful *Watsonia* (in the Lily family), 18 inch spikes of pink flowers similar to our gladiolas. These come in all colors but purple. I put them in the vase on our bus and they lasted a week.

One well designed garden we saw was at the University of Canterbury Faculty Club, a former private estate. The garden had a lovely stream and waterfalls along which were the giant leaves of the *Gunnera*. There was a playfield with lawn of browntop with Chewings fescue, a bowling green which used *Cotula*, a round leafed turf. For a lawn tennis court, twitch grass was the groundcover. We saw *Clematis montana*, Buch.-Ham. large, white, and profuse, with four petaled flowers, and one Shirley poppy (opium) 6 feet high with 6 inch white flowers.

November 17 — Dunedin, named for Edinburgh in Gaelic, is a hilly city with a mostly Scotch population. Here is the University of Otago, oldest in New Zealand, founded in 1869, which has 8000 students.

The Botanic Gardens has large beds of *Ranunculus*, 4000 bulbs in every color, a *Pinus radiata* 85 feet tall and 7 foot caliper, and large *Eucalyptus*.



Myosotidium hortensia

November 18 and 19 — Queenstown on Lake Wakatipu

On the way to Queenstown we drove through rugged gorges. There is to be a large dam in the Cromwell gorge which will flood an orchard growing area to make the largest lake in New Zealand which is to be used for power and recreation. It is due to be finished in 1990. We get their Granny Smith apples here in Denver. There were more large areas of gorse and scotch broom in pink,

rust, maroon, and yellow, and masses of purple flowering thyme for miles. We saw vegetable sheep on the scree slopes, *Haastias* and *Raoulia* of the Compositae, flat masses of gray-white which look remarkably like sheep on the hills.

At Queenstown, on the shores of the lake, we could see mammoth trout, fat and 24 inches long. In the town we saw more of the giant spikes of 10 foot *Echium*, purple and pink.

November 20 — On our way to Mount Cook, called Mount "Cookie" by our Maori driver, *Lupinus* by the acre, miles and miles of pink, purple, blue, yellow, white, and coral, especially down near Omoroma River Valley, was spectacular! We said it was "Colorama near Omoroma".

The rivers from the glaciers in these Southern Alps are milky from the glacial dust. Fish cannot breathe in these waters.

November 21 — It was overcast when we arrived at the hotel the night before, but at 6:00 A.M., what a fantastic surprise to see a pink snowcapped Mount Cook, 12,349 feet high, in all its glory. We saw the lovely rare and exciting Mount Cook lily — *Ranunculus lyallii* Hook. — with flat shiny, large leaves, the flower is 6 inches of pure white with yellow stamens. The plant is about 30 inches tall.

Reluctant to leave this wonderland of flora and fauna, I decided that if ever I retired, I would zip back to this gardener's paradise, where one could happily grow plants from the tropics to the alpins.

Australia — November 21 - 23
Sydney is a city of jacarandas and red tile roofs. Our old friend Christmas trees, pohutukawa, were in full bloom. The great event was the tour of the magnificent harbor in a small boat; 28 of us had dinner on board at sunset. The trip back with all the lights of the city reflecting in the water and that fantastic opera house lighted up with the great bridge framing it was unforgettable! The real highlight was the tour of the great opera house and dinner before the performance of the ballet, "Don Quixote."

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We saw oleander, 60 foot tall bamboo, *Melaleuca* or *Protea*; 8 feet high and 8 feet wide hydrangeas, palms, and Norfolk Island pines at 80 feet.

November 26 — Brisbane is a city of *Poincianas*. The Old Botanical Gardens are beautifully laid out as a spacious park with lawns, ponds, and vistas in the center of the city. We saw an upright willow very like the form of a bolleana poplar.

I went out with a bunch of
botanists on a tour trek,
Which left my mind a total wreck.
I never could quite see
Why they would take a lovely pine
tree
and give it a name like *Ignoramus
imbecillicus*,
Such a name is not really worth
the fuss.
The gorgeous countryside and
flowers I did see,
Really impressed me with their
beautee.
This ditty I'm sure you will agree
Is written in free verse,
Than which there is nothing more
worse.

Anonymous

Exotics of Colorado

Tulips, *Tulipa*

18 Helen Marsh Zeiner

Tulips (*Tulipa* spp.) are the most popular of all the hardy spring-flowering bulbs, both because they are very showy and because they are easy to grow.

Nearly everyone knows how to raise beautiful tulips, but not everyone knows their interesting history.

The exact origin of the garden tulip has been lost in antiquity. We do know that there are many species of the genus *Tulipa*, perhaps as many as a hundred, native to Siberia, Turkey, Asia Minor, China, Japan, and the Mediterranean countries of Europe. Tulips were grown in Turkish gardens from very early times, but there are no records of which wild species were collected and cultivated. Tulips were favorites of Turkish sultans who organized tulip festivals and honored those growing new varieties. Many old palaces and mosques in Istanbul were decorated with tulip figures. Even today the tulip is a favorite design on Turkish tiles and in Turkish embroidery.

One small tulip representation on a Cretan vase is estimated to be 3500 to 4000 years old.

Tulip seeds were sent or brought to Vienna, Austria in 1554 by Busbequius, the Austrian ambassador to Turkey. Busbequius first saw tulips growing in a garden near Constantinople, and he reported that he "had to pay dearly for them." After the introduction of the tulip to Vienna, tulips quickly spread over Europe, both by means of European-grown seed and by new varieties brought from Turkey.

One of the oldest drawings of a tulip was made by Clusius, an herbalist and a professor of botany in Leyden, Holland. This drawing appeared in 1576 in one of Clusius' works. Clusius became a tulip fancier who began



Tulipa sp.

propagating many tulips about 1591. He is said to have charged so much for his bulbs that many were stolen and some of his gardens ruined. It was largely due to his specimens that Holland became greatly interested in tulips.

Clusius is believed to have introduced the tulip to England about 1577. Tulips were immensely popular in English gardens until they were replaced by new and novel plants introduced from America at the beginning of the eighteenth century. Tulips never fell completely into disfavor, however, and were still to be seen in many English gardens, particularly those of the poor.

The craze for tulips among the Dutch became so great that "tulipomania" took over Holland in 1634. New varieties of tulips were a potential source of great profit and resulted in the wildest speculation on new varieties of bulbs. The price of bulbs was often more than that of precious metals. The Associated Bulb Growers of Holland quotes a record price for one bulb: "A load of grain, 4 oxen, 12 sheep, 5 pigs, 2 tubs of butter, 1000 pounds of cheese, 4 barrels of beer, 2 hogsheads of wine, a suit of clothes and a silver drinking cup."

After a period of four years the Dutch government intervened to end the speculation on tulip bulbs. After the craze subsided, the production of tulip bulbs proceeded in a saner fashion and has persisted in Holland to the present time so that Holland is still the center of the bulb-growing industry of the world.

Most garden tulips today are said to be derived from *Tulipa gesneriana* L., but this does not mean that this was an original

species. In 1753 Linnaeus grouped all the garden tulips he knew under this name. It was mainly on detailed descriptions and pictures by the botanist Gesner, who saw the tulip in Augsburg in 1559, that the species was founded. However, these tulips had already been cultivated in Europe for two centuries and much longer than that in Turkey, and in no way could they be considered the original species.

Although there are many classes of modern tulips, the Darwins are the most popular tulips. They were first offered for sale at Haarlam in 1889 by Krelage and Son. The first parrot tulips were introduced towards the end of the seventeenth century. They were developed by the French, and at first were considered monstrosities. Double tulips were pictured in 1613, although 1665 is the date for the authentic record.

Tulipa comes from the Persian word "toliban" meaning turban because the inverted flower resembles a turban. It is a very old name.

As with many "old" flowers, interesting myths and legends have grown around the tulip. One charming old English Legend says that the pixies put their babies to bed in tulip flowers, where they were safely cradled and gently lulled to sleep by the winds.

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1979 Annual Plant Trials

20 **Beverly M. Nilsen**

Selection of varieties for the annual plant trials falls into three main groups. There are varieties that are being tested for various seed companies. At the end of the growing season a report is sent to the companies involved. Several of these varieties will be introduced to the commercial trade in future years. Secondly, there are varieties that are new on the market for the current year (shade varieties excluded). Thirdly, there are varieties that we select in order to determine better or different annuals to be used in our own display beds. Also, included in this area, but not undergoing testing, are the current and upcoming All-America Selection (AAS) winners. These varieties have already been through extensive testing and were determined to be superior.

Approximately 50 plants of each variety are used. Judgments are based on several factors. These are — plant growth habit, plant vigor, uniformity of plants in height (h) and width (w), amount of bloom, period of bloom, uniformity of bloom color and type, tendency of flowers to fade or bleach, height flowers are borne above the

foliage, disease resistance, and overall appearance. To select a dependable variety that performs well consistently takes several years of testing and competition against varieties of like type. A one year test indicates only potential.

Ageratum

‘Blue Jay’ — h - 4"; w - 5" to 12"; medium blue; not uniform; not impressive

‘Capri’ — h - 7"; w - 14" to 16"; medium blue, produces very good amount of bloom on uniform plants; appears to be a good variety

‘Cut Wonder’ — h - 26"; w - 20"; medium blue; not heavy bloomer but produces some bloom all summer; would not be effective in a large group as a bedding plant; extends use of *Agertum* from border to background; useful as cut flower because of long stems

Antirrhinum (snapdragon)

‘Floral Carpet Mix’ — h - 6"; w - 9"; mix of yellow, red, pink, rose, and bronze; produces good amount of blooms with rich colors; use as border plant; also available in single colors

Begonia

‘Foremost Pink’ — h - 5"; w - 7"; rose; better varieties on the market than this one

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Calendula

'Mandarin' — h - 15"; w - 14";
bloom size 1¾"; yellow orange;
blooms when plants are 6" high;
adequate amount of blooms but
color is washed out; not exciting

Capsicum annuum L.

'Black Prince' — h - 9"; w - 9";
need to plant about 10" apart to
achieve cover; purple-black leaves;
tiny inconspicuous purple star
shaped flowers; purple-black
candlelike fruits which turn bright
red; upright growth habit;
different; interesting in the right
location

'Holiday Cheer' (AAS 1979) — h -
5"; w - 7" to 10"; small mounds
covered with round fruits turning
from yellow to red; also different
— a few plants in selected places
would be effective

'Holiday Time' (AAS 1980) — h -
4½"; w - 6"; fruits tapered, turning
from yellow to red; not as effective
as 'Holiday Cheer'

Centaurea

'Frosted Mix' — h - 22"; w - 15";
bloom size 1¼"; mix of pink, red,
purple, white/purple center and
white/pink center; too many
blossoms with light colors and the
so called frosting only shows up
well on the purple

Clarkia

'Novelty Mix' and 'Rainbow Mix'
— h - 12" to 15"; w - 18"; mix of
shades of pink and rose; plants
floppy and sprawly; out of bloom
in early August; not effective.

Dianthus

'Queen's Court' — h - 6"; w - 6";
bloom size 1¼"; mix of medium
red, dark red, deep rose, pink,
pink/red center and lavender/
white edge; plant 6-8" apart for
best effect; good mix of colors

Geranium — eight tested, none
appeared to be anything
exceptional

'Fire Flash' — h - 16"; w - 14"; red
'Knockout' — h - 14"; w - 12"; red
'Mustang' — h - 16"; w - 18"; red;
one of the best of the group

'Orange Punch' — h - 15"; w - 12"
to 16"; orange; color is distinctive;
one of the best of the group

'Red Apple' — h - 15" to 21"; w -
9"; red; performed quite poorly

'Red Express' — h - 18"; w - 15";
red (deeper color than 'Mustang' or
'Fire Flash')

'Ringo Rose' and 'Ringo Salmon'
— h - 10" to 13"; w - 10" to 15";
color as named; each has white
center

Godetia

'Dwarf Double Azalea-Flowered
Mix' — h - 12"; w - 14"; bloom size
2"; semi-cup flower shape; mix of
pink shades, lavenders, rose and



Tagetes 'Paprika'

white; not all blooms are double; some blooms tucked into foliage and not too visible; continues to bloom later than 'Monarch' but not as pleasing

'Monarch Dwarf Single' — h - 4" to 8"; w - 6" to 10"; bloom size 1¼"; same mix of colors as above; produces excellent amount of bloom; finished mid-August; it should continue blooming much later if planted in semi-shade

Mimulus

'Royal Velvet' — h - 9"; w - 9" to 13"; bloom size 1½"; tubular flower shape; wide maroon edge with yellow throat that is flecked with maroon; moderate to good amount of bloom; prefers semi-shade and did very well for being planted in full sun

Petunia

Several petunias were tested but there appeared to be some problem with the soil in this area. Plants did not do well overall so it was unfair to collect data and make any judgments as to good and not-so-good varieties. However, one observation was made. Four yellow varieties were tested — 'Butterscotch', 'Moonglow', 'Sunburst', and 'Summer Sun'. The latter is the deepest yellow in color. Of the other three there is no appreciable difference in color, all are pale yellow.

One variety 'Blue Frost' was planted elsewhere in the garden and performed well. It has a different bicolor pattern — deep violet blue with ¼" to ½" white border. The 3" grandiflora blooms tend to curve under at the edge.

Rudbeckia

'Rustic Dwarfs' (also called 'Rustic Colors') — h - 18"; w - 18"; bloom

size 3½"; gold, some rust, all with brown centers; produces excellent number of blooms

Salpiglossis

'Bolero', 'Emperor' and 'Splash' — h - 15"; w - 6"; blooms size 1¾"; mix of colors; none of these performed well at all, plants did not fill out and did not produce adequate bloom

Salvia

Two groups were tested — *S. farinacea* Beuth. and *S. horminum* L. The red salvia often seen in bedding displays is *S. splendens* F. Sellow. The main difference in the *S. farinacea* varieties tested was height. There is no noticeable difference in color, all are deep blue. Width or spread of plants is uniformly about 16". These salvias make good background plants, are useful for cut flowers as well as dried material. All varieties performed very well.

'Blue Bedder' — h - 23" to 29"

'Blue Spike' — h - 30" to 39"

'Catima' — h - 23" to 29"

'Victoria' — h - 18" to 20"

'White Bedder' — h - 23" to 30"; silver grey; companion to 'Blue Bedder'; would need a stimulating color adjacent to show it off.

An interesting group are the *S. horminum* varieties. These would be worth trying for a change of pace. They are called the foliage salvias. The color appears in the foliage and the flowers are inconspicuous. They bloom all summer, have soft dusky colors, and add a light colorful touch to the garden. They remind me of butterflies. All three varieties tested performed well. Also, they may be used as cut flowers and as dried material.



Salvia horminum

'Blue Bird' — h - 17"; w - 20"; purple; several plants with blue in the name are actually purple in color

'Monarch Bouquet' — h - 26"; w - 22"; mix of white, pink, and purple

'Pink Sundae' — h - 20"; w - 20"; rose pink

Sanvitalia procumbens Lam.
(creeping xinnia) — h-9"; w - 17"; bloom size 1"; yellow with dark button center; covers well and produces a carpet of continual bloom; would recommend

'Gold Braid' — h - 13"; w - 17"; bloom size 1"; the only difference from the above is that this cultivar is slightly taller

Schizanthus

'Dr. Badger's Hybrids' and 'Hit Parade' — both varieties died as soon as planted out; better reserve this plant for the house

23

Tagetes (marigold) — A large selection of single marigolds was tested in addition to the usual double ones. These are sometimes overlooked as bedding plants for no good reason that comes to mind. They produce a lighter, more airy display than many of the doubles. Several varieties of both single and double were tested. Because of the large number only the varieties that performed well are listed here.

SINGLE

'Cinnabar' — h - 16"; w - 19"; bloom size 2"; mahogany edged gold with yellow crested center, fading to rust; however, color progression is pleasing

'Naughty Marietta' — h - 20"; w - 18"; bloom size 2"; golden yellow with mahogany at center; been on the market many years but continues to be one of better varieties — also, available is 'Dainty Marietta' a shorter version at 14"

'Nell Gwyn' — h - 25"; w - 22" to 26"; bloom size 2½"; golden yellow; listed as daisy flowered; large petals; interesting



Capsicum 'Holiday'

'Paprika' — h - 10"; w - 16"; bloom size $\frac{3}{4}$ "; mahogany/gold; fern-like foliage; this variety created more interest than any other variety in the entire test area; would be interesting in rockeries; try it

'Sunny' — h - 14"; w - 16"; bloom size $1\frac{3}{4}$ "; yellow; blooms very well; color bright and clear

DOUBLE

'Janie' (AAS 1980) — h - 9"; w - 14"; bloom size 2"; deep gold; produces exceptional amount of bloom; nothing unusual, just basic double marigold

'Orange Boy' — h - 12"; w - 16" to 18"; bloom size 2"; orange; produces excellent amount of bloom — other varieties of the 'Boy' series are good but this is the best of the group

'Queen Sophia' (AAS 1979) — h - 15"; w - 16"; bloom size $2\frac{1}{4}$ "; russet with gold edge on petals; color progression to rust-orange; large petals; produces excellent amount of bloom; softer look than many doubles

Zinnia

'Cupidon Elite' — h - 23" to 28"; w - 18"; bloom size $1\frac{1}{2}$ "; button type; mix of medium and dark red; orange, cream, pink, salmon, and yellow; blooms very well but not uniform in height; colors not vivid

'Gold Sun' (AAS 1979) — h - 20"; w 18-20"; bloom size 4-5"; blooms have rounder petals than the 'Peter Pan' series; does extremely well; would recommend

'Peter Pan Flame' (AAS 1980) and 'Peter Pan Gold' (AAS 1979) — h - 14"; w - 14"; bloom size $3\frac{1}{2}$ - 4"; color as indicated in name; both varieties produce an excellent amount of bloom on full bushy plants; color holds well; would recommend

When you have finished judging and after you have selected the best and the worst, someone walks up and stops by the lowest rated variety of the bunch and exclaims "Oh, Ethel, isn't this one just lovely? I'd like to plant some of these by my front porch. Just look at that color." — Thus it will always be.

Some Factors That Affect Tree Growth

George S. Stadler

The transition of the Denver area from a wide open, windswept prairie with sparse population to the present area of urbanized civilization escapes the realization of most of its citizenry. Soils, atmospheric and humidity conditions relating to growing sites for trees have been subjected to many modifications during the period from the early 1900s to the present date. The maze of buildings, roadways, utilities — both underground and overhead — and human use of space has constantly increased and undoubtedly will continue to do so.

Supplemental irrigation with controlled supplies of water rendered potable for safe human consumption has altered — and still is altering — the water soluble content of our soils. Water tables have been changed in depth and salinity. Gaseous content of soils (oxygen, carbon dioxide, methane) is in a transient state with resultant reactions of micro-organisms capable of modifying the adequacy and adaptability of the soil as a suitable medium for plant and tree growth.

Mr. George S. Stadler was Denver's City Forester for 16 years, and served with the U.S. Forest Service. He has written articles about his favorite subject in other issues of *The Green Thumb*.

Insect and disease introductions 25
have found a choice medium for build up and attack free of natural controls, and vice versa some have probably been eliminated by native resistance factors of which we have little or no knowledge.

Tall buildings and structures, including older and larger established trees have altered sunlight intensity by casting shadows on surface soils at least for portions of daylight hours. Even the intense lighting of streets and use of increased night lighting in general possibly have some effect on at least certain of our trees and plants.

Atmospheric content, particularly during periods of inversion resulting in trapping and holding of carbon dioxide as well as other gases and particulate matter becomes still another factor capable of affecting actions and reactions of living plant metabolisms.

All of this calls forth a challenge to study reactions of tree growth under presently existing conditions, particularly those of individual trees which appear not only to adapt but to be stimulated by same. Within their genetic capacities certain trees undoubtedly have greater

capabilities of survival and growth than are presently recognized. Trees are controlled by both hereditary and environmental factors and require growing locations capable of supplying basic needs. Selecting and planting of trees with an intent of survival here has been largely on a trial and error basis.

Introduction of new species from time to time has occurred, sometimes successfully, sometimes not. Under such circumstances the exception rather than the rule became apparent to only a few sagacious individuals who were unable to propagate and perpetuate those valuable exceptions which ultimately were lost.

The life span of trees often exceeds that of humans who plant them — a condition leading to a popular demand for trees capable of fast growth and rapid development, which is readily understandable. In general, however, such fast growing trees tend to be of weak structure, subject both to damage by decay organisms and to being badly broken by the unseasonable early and late snow and ice storms typical of the area. Those deciduous trees which leaf out later in spring and drop their foliage earlier in the fall thus escaping serious snow and ice damage are not generally of a fast growing character. Even the evergreens which originated in nearby mountain forests sustain some damage from snow and ice, but generally to a lesser degree, dependent usually on the amount of the over stimulation of growth in their transplanted locations.

The Denver environs were practically devoid of trees in the not too distant past, although they are now well shaded with nursery

stocks brought in from many geographic locations. The present tree growth thus has a greatly varied ancestral background.

Cross pollination of such diversified strains undoubtedly can produce some seedlings with unusual characteristics involving appearance, size, rate of growth, and survival potential.

Consideration should also be given to the fact that much of this parent stock has been derived from areas of lower altitudes and is now growing under the more intense solar radiation of our mile high atmosphere. Recognizing the capabilities of genetic processes in tree seeds and realizing the abundance of seed which can be produced by just one mature tree one expects the odds of surviving catch seedlings with unusual and possibly superior growth capacities should be higher than such seedling reproduction in older well-established forested areas.

In my travels throughout the Denver area over the years, plus a professional interest in trees and woody plants, I have had opportunities to observe many local occurrences of tree seedlings in chance locations. Production of viable seed in parent trees varies from year to year and survival and growth of seedlings in catch locations has a still greater degree of variance. Dissemination of such seed is effected by both natural factors and actions of humans in a manner to produce seedling growths in very surprising locations. Also the eventual development of these chance seedlings into mature forms undergoes an extremely high degree of mortality, since they are generally treated as weeds and destroyed or allowed to die. The very few of such seedlings which are cultivated and do survive are

rarely recognized in later years as being derived from local origin.

Recognition of unusual growth characteristics in a seedling tree is undoubtedly difficult and debatable but possible to a degree. Juvenile forms of growth may vary from mature form, and interaction of environment can lead to error in human judgment in selecting mutants and variants in the seedling stage of growth. An apparent desirability of certain unusual characteristics may or may not prove out over the entire period of a tree's lifetime.

Within the boundaries of this elementary reasoning and speculation, I have over the years conducted some very limited experiments within the small yard of my home in Denver, involving survival and growth of some

selected seedlings. The following woody plants represented by one or more specimens, varying from first year seedlings to larger sizes, are presently existent and offer some possible adaptation and survival potential: shagbark hickory, hickory-pecan cross, white walnut, black walnut, American beech, Chinese pistachio, hazelnut (2 varieties), edible chestnut, apple, red oak, native scrub oak, Norway maple, yellow-wood, red gum, redbud, dogwood (tree form), way-faring tree, *Euonymus*, *Sapindus* (soapberry), tulip tree, juniper, hemlock, American holly.

27

It is not expected that all of the tree growths listed here will withstand the rigors of Denver climate and soil over any extended period of time, but some of the results involved so far have been extremely interesting.



Horse Chestnut

Elm Disease Control

Jim Knopf

28 *Ulmus americana* L. (and several other important elms) may soon be truly rescued from the specter of extinction through research currently being coordinated in Minnesota.

The implications are really exciting. Not only could this mean that the character of many cities might be maintained (by saving many of the remaining large elms), it would also save huge sums of money now spent in elm removal programs. Perhaps most important, we would have the elm to use again in urban landscaping.

Here in the Rocky Mountain West where shade tree species are limited, American elms could, for example, significantly reduce our over-planting of honeylocusts.

This bright news in the war against DED (Dutch Elm Disease) is based on two general areas of attack — control of the DED fungus and control of the disease-carrying beetles.

Jim Knopf is a registered landscape architect, Professor of Landscape Architecture at the University of Colorado, teaching classes both in Boulder and in Denver. He has a Master's Degree in the subject and was responsible for developing the requirements for the degree of Master of Landscape Architecture for the University. Previously he served for some years as a Peace Corps volunteer in Africa.

DED Fungus Control

A team from Montana State University has shown that the bacterium *Pseudomonas syringae* produces an antibiotic which inhibits the growth of the DED-causing fungus. Field experiments using this bacterium have proven highly successful both in preventing trees from getting DED and in curing trees with up to 30% crown damage from DED. It is reported that this bacterium can be grown in quantity, freeze dried, and re-activated by mixing it with sugar and water. Simple kits can be used to feed it into a tree where it is readily transported through the tree and where it is reported to winter well. It is also known to reproduce in the tree and can be carried from tree to tree by the beetles.

In addition, the Montana State team has developed a method for rapid detection of DED in infected trees. This is based on a special antibody made in rabbits and spots minute traces of the fungus in the tree sap.

These are extremely encouraging developments in terms of protecting and curing individual trees. However, overall control of the disease will require additional strategies. A team at the State University of New York, Syracuse has been working on some of these.

Beetle Control

Effective overall control of the disease will continue to require an attack on the disease carrying beetles. Strategies for this will continue to involve destroying diseased and dead wood as well as limited spraying.

In addition, however, it now appears possible to bait and trap the beetles, thus effectively prohibiting mass breeding. When ready to mate, the beetles are attracted to each other by the emission of very specific pheromones (sex attractants). The elm tree also emits a beetle attracting chemical when under disease stress. By combining these chemicals in the proper amounts workers can divert the beetles from healthy trees to traps, thus preventing mass breeding. This same technique will also be useful in detecting movements of beetles to new areas.

Another related strategy is to inject hopelessly diseased or unwanted trees with cacodylic acid. This attracts large numbers of native beetles. The same tree can also be baited with an artificial pheromone to attract European beetles. Both species will bore into the tree but their breeding will fail due to herbicide-induced drying of the bark. It is reported that in Syracuse, where this technique has been tried, DED has declined significantly as a result.

This research on beetle and DED fungus control has been coordinated by the Fresh Water Biological Foundation in Minnesota and has been labeled DUEL (Dutch Elm Research Project).

The foundation reports that in 1980 there are plans to publish additional results of tests on the antibiotic produced by *Pseudomonas syringae*. Also, a second year of testing herbicide treated "trap trees" will be carried out in a 10 square mile area of the Twin Cities. Sticky paper traps for control of European bark beetles should also become available. Upon EPA approval some of the fungus control agent may also be procurable.

29

All in all these are extremely encouraging developments which warrant considerable attention.

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Ulmus americana

Mitchell Retires as D.B.G. President

After having served as President of the Board of Trustees of the Denver Botanic Gardens since 1968, Mr. John C. Mitchell II retired from that office in January 1980. His place as presiding officer was taken by Mr. Richard A. Kirk
30 who has served as vice-president for several years.

Issues of *The Green Thumb* and of the Annual Report of Denver Botanic Gardens, Inc. detail the accomplishments of Mr. Mitchell during his 12 years as president. He was chosen as a trustee in 1961 and in 1964 was selected to be treasurer. In 1968 he became president.

Many of the major events in the history of the Denver Botanic Gardens took place during the years Mr. Mitchell was in office.

The first of two campaigns for funds was conducted in 1968 when more than \$850,000 was raised. The drive for funds in 1977-78 which had a goal of \$1,500,000, actually produced more than \$1,750,000. These two drives have made possible many of the hoped for improvements at the gardens.

The popular travel program which has taken Denver Botanic Gardens members to many places in the world was started at Mr. Mitchell's suggestion. He also was instrumental in re-establishing the Annual Dinner and helped in making the Annual Report a vital part of the program of the Gardens.



John C. Mitchell II

Members of the Board of Trustees prepared a Certificate of Appreciation which was presented to Mr. Mitchell at the annual meeting in January. A copy of the certificate is on the following page.

Mr. Mitchell will remain on the Board of Trustees and on the Executive Committee where his years of experience will enable him to continue to serve the Denver Botanic Gardens.

Bill Anderson




Certificate of Appreciation

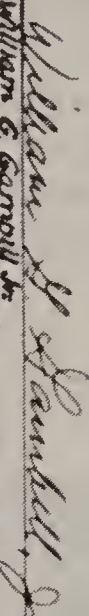
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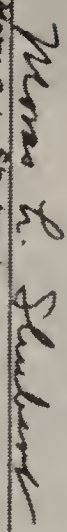
John C. Mitchell II

President, Denver Botanic Gardens, Inc., 1968 to 1980

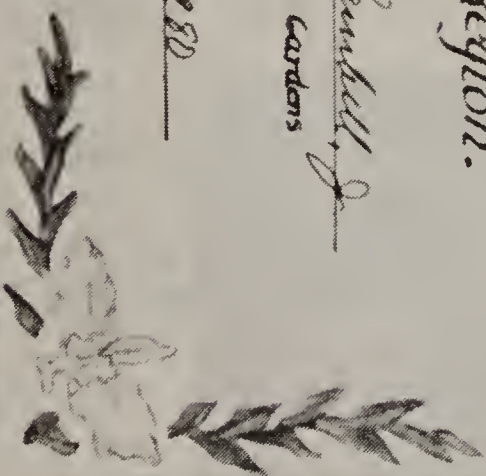
By the Trustees, Staff and Members of the Denver Botanic Gardens, in recognition of his leadership role in the development of the Botanic Gardens and his devotion to bringing horticultural beauty and educational opportunities to the citizens of Denver and the Rocky Mountain Region.


Richard A. Kirk
President, Denver Botanic Gardens, Inc.


William G. Garroull Jr.
Director, Denver Botanic Gardens


Morris L. Shubert
Secretary, Denver Botanic Gardens, Inc.

Date 22 January 1980



Perennials in the Amphitheater

Andrew Pierce

32 Amongst the Gardens plantings certain areas stand out as being culturally very difficult due to extraordinary influences. Such a position is the amphitheater where at certain times of the year it is baked by the sun, flooded by water runoff from the surrounding banks, walked on by many feet of the public, and in the winter no doubt has a microclimate even colder than the rest of the gardens due to cold air collecting in its low level.

The large paving slabs of sandstone also get very hot in the summer and additionally have very limited planting space between them. In the past, dwarf thyme, a delightfully scented herb, had been planted as a ground cover between these slabs and could generally be considered as

unsuccessful in most of the area though in a few sections it grew happily.

This past fall we put more thought on what would perhaps survive such conditions, and on a trial basis we have planted portions of the site with the following:

Dianthus X arvensis, *Nepeta hederaceae* L., *Penstemon caespitosa* Nutt., *Sedum acre* L., *Veronica allionii* L. and *Veronica pectinata* L.

The idea behind this is to come up with a generally acceptable plant for all of the area. It may mean that a mixing of plants will be the answer, but the criteria for such a locality are limiting to say the least.



Amphitheater

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The Cover
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The Green Thumb

Summer 1980

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William H. Anderson, Jr.
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Denver Botanic Gardens, Inc. maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Enjoy the Fungal Flowers

George L. Grimes

- 34 Few people would dare think of kicking a wild flower while walking through the forest. Yet, at some time or other, all of us have kicked a toadstool or wild mushroom.

Toadstools have a vile reputation and seem to be maligned. When we learn the common term "toadstool" is technically synonymous with "mushroom", (because both are fungi (fun-ji) and there is not always a clear cut line of toxicity) we become a little more understanding and friendly toward these strange bodies, the fungal flowers.

The wild mushroom is no longer maligned as before. In fact, an appreciation for these unusual plants is growing. Within the last few years, many new books about mushroom identification have been published. There are at least 35 mycological societies or mushroom clubs around the United States, where mycophiles gather to

discuss, teach, learn, photograph, taste, and participate in mushroom forays for food, fun, and scientific study. So, mushrooms are now better understood.

Mushrooms are not true plants like the green, vascular plants. They are the flowers, or fruit, that grow from the concealed mushroom plant of mycelial threads in its supportive substrate of soil, wood, dung, or another mushroom.

Since they are fungi, they are botanically quite different from the green plants. A simplistic definition of a fungus is that it is a spore bearing structure that does not require chlorophyll nor photosynthesis in the manufacture of its food.

There are thousands of kinds of mushrooms, all of which reproduce by means of microscopic seeds, or spores, that can be seen with the naked eye only in deposited groups and individually by high magnification. The color of a spore deposit is an important clue to the identification of wild mushrooms.

Mr. George Grimes is a very active member and past president of the Colorado Mycological Society. He regularly teaches classes in Wild Mushroom Identification for a national seminar on mycology in Aspen, Colorado and at the Botanic Gardens.

Of the thousands of kinds of mushrooms, many are a beauty to behold. There are variations in the classic umbrella shaped mushrooms in minute characteristics,

anatomical features, odors, textures, sizes from pinhead to over a foot in diameter, and colors throughout the visible spectrum from white to black.

Our concern here is to learn to admire and enjoy the beauty of the mushroom flowers with disregard to their edibility, just as a horticulturist does not give thought to the edibility of a rose, oleander, or Chinese elm.

Frequently, during spring, summer and early fall, when you step onto your lawn, you see that there is a flower garden at your feet in the form of fungal flowers. Some of these flowers may be quite small, delicate and fragile, such as *Conocybe tenera* (Schaeff. ex Fr.) Fayod. These will "mushroom" at dawn, with their striate, bell-shaped, tannish caps melting away to nothingness from the heat of the noonday sun.

Scattered throughout the grass could be some interesting brown mushrooms that produce rich brown spores, *Agrocybe praecox* Fr. Both genera are in the Bolbitiaceae family.

Your lawn may produce the attractive white spored, *Marasmius oreades* Fr., family Tricholomataceae, with neatly striated, light buff caps dancing in a fairy ring, perhaps to your dismay, but delightful to see.

Many older lawns of Denver, and elsewhere, yield a robust, handsome mushroom, *Chlorophyllum molybdites* Mass., family Lepiotaceae. It is white overall except for the buff tinted scales on the globose to broad flat cap and the grayish-green gills on the underside. The unusual gray-green

spore print is distinctive. At maturity, a fluffy collarlike ring can be moved up and down the thick, white stem. This large fungus often grows in fairy rings several feet in diameter, and is a breathtaking display of white against the lush green of the lawn.

You may see several members of the Coprinaceae family, also. One, a tall, white, statuesque, scaly, black-spored enticing specimen is the *Coprinus comatus* (Mull, ex Fr.) S. F. Gray. It will survive for a day or two, only to deliquesce at maturity into a pool of black ink.

Another, reddish-brown turning to a lighter brown, is small, with a graceful stem holding the fragile, convex cap barely above the grass blades. The mottled appearance of the gills is from the black spores maturing in clusters. This is *Panaeolus foenisecii* (Fr.) Kuehner.

A fantastic bouquet of hundreds of tiny, gray brown caps may appear where there is decayed wood in the



Marasmius rotula

soil. These minuscule fungus blooms are *Coprinus disseminatus* (Pers.) Fr. Another in this family is the *Psathyrella candolleana* (Fr.) A. H. Smith, with its cream color cap and scalloped margin. The older caps may flare upward to reveal a white, shiny stem and purplish-brown gills.

36 There are other varieties of fungal flowers growing in lawns, parkways, golf courses, and meadows for you to enjoy. One, in the Agaricaceae family is *Agaricus campestris* L. ex Fr., the field or meadow mushroom. It can grow 8" or more across. Its brilliant pink gills and whitish cap when young are fascinating to watch over the next day or so, when the gills become dusty rose and then dark chocolate brown, the color of the spores.

In late May or early June, the true morels, *Morchella dillenensis* ex Fr. and the false morels, *Gyromitra* Fr. and *Helvella* Fr. present a pretty picture as they thrust their cream, brown, or reddish-brown pitted or convoluted heads upward in unusual charm.

As you walk through the high foothills into the Montane Zone, other types of mushrooms will be found. Yellow, brown, and brick-red capped forms that do not have gills beneath the cap, but rather thousands of pores from which their spores fall, the *Suillus* S. F. Gray and *Leccinum* S. F. Gray genera dot the woods with color. In the Montane Zone, more species come into view on the forest floor such as the *Boletus* L. ex Fr.

Hydnum imbricatum Fr. produces its brown spores from long spines hanging beneath a cap of overlapping, deep brown, thick scales.



Hygrophorus conicus

Also in the family Hydnaceae, the white spored *Dentinum repandum* (L. ex Fr.) S. F. Gray shows off its orangey to pinkish, smooth, buff caps, with cream-colored spines beneath.

One of the most fascinating of fungal bouquets grows on decayed conifer wood and produces a buff spore print. A member of the Tricholomataceae family, *Xeromphalina campanella* (Fr.) Kuehn. and Maire is a pleasant orange-brown, the gills gracefully extending down the tiny stem. The young fruiting bodies may be only the size of a pinhead, clustered among perhaps a hundred caps of more mature and somewhat larger diameter.

Laccaria laccata (Fr.) Berk and Br. is common in the Montane Zone, its widely spaced, pinkish gills

sloping into the stem. The cap color varies from pinkish-tan to an impressive rosy wine color, and like many other members of the Tricholomataceae family, has white spores. *L. amethystina* (Bolt. ex Hooker) Murr. is a deep violet color, adding variety to the forest floor. Many species in the genus *Cortinarius* Fr., have violet and lilac hues.

Late in the summer, you may see *Cantharellus cibarius* Fr. in the Montane and Subalpine Zones, in natural floral arrangements nestled in the pine needles. Striking yellow-orange to reddish-orange, they do not have true gills, but decurrent, blunt, forked folds, producing pale yellow spores. Their distinctive vaselike shape is easy to recognize.

The coral fungi are a delight to anyone, as they resemble the coral of the sea. The Clavariaceae family includes remarkable shapes, many club- and fingerlike projections from the soil, numerous branched species and highly colored ones (yellows, oranges, purples, pink and red-oranges).

There are hundreds of mushrooms that could be included in this list of fungal flowers, and these you will see on your mushroom walks. Scattered throughout the Foothills and up through the Subalpine Zones, are numerous, colorful species. Very few are found in the Alpine Zone.

The Hygrophoraceae family includes several colorful species, usually yellowish, orange, and bright red. *Hygrophorus conicus* (Fr.) Fr. is bright orange-red; *H. miniatus* (Fr.) Fr. is brilliant scarlet; *H. flavescens* (Kauf.)



Amanita muscaria

Smith and Hesler, an orange-yellow; *H. coccineus* (Fr.) Fr. bright blood red; and *H. chrysodon* (Fr.) Fr. white with yellow areas add to the rainbow of colors.

The Russulaceae family contains a large variety of color, the more spectacular being *Russula lutea* (Huds. ex Fr.) S. F. Gray, bright yellow; *Russula emetica* (Fr.) Pers., bright red; *Russula xerampelina* Fr., purplish-red; *Russula aeruginea* Lindblad ex Fr., grass green; and *Lactarius indigo* (Schw.) Fr., deep blue. Other colorful Tricholomataceae members are *Clitocybe odora* (Fr.) Kummer with its aniselike odor and blue-green cap; the tiny and dainty *Marasmius rotula* (Scop. ex Fr.) Fr. is exquisite and *M. androsaceus* L. ex Fr. is a jewel. The coral-red delicate *Mycena adonis* (Bull. ex Fr.) S. F. Gray is indeed a tiny flower.

Some of the most striking and beautiful fungal species are in the Amanitaceae group, a highly toxic family. All have white spores and distinctively have some type of enlargement and cuplike configuration at the base of the stem. Many have warts on the cap and most have a ring on the stem. The *Amanitas* range in color from pure white, yellows, oranges, and reds to greenish and browns. The most popular conception of a colorful mushroom seems to be the orange-red to blood-red *Amanita muscaria* (Fr.) S. F. Gray commonly called the "Fly Agaric". It rates as one of the world's most beautiful and dangerous mushrooms.

Throughout the varying altitudes of this region are mushroom flowers with fantastic shapes, muted and vivid colors, and strange characteristics. There are the "puffballs", pear-shaped and round of various diameters; unique "earthstars" standing on legs; "bird's-nest-fungi" resembling miniature bird's nests complete with eggs; colorful "jelly" fungi, usually brilliant yellow, orange, or red-orange; rose, orange, brown, and scarlet cuplike formations; cream-colored fronds; shelflike fungi on tree trunks; "earth tongues" and others in a wide range of tones, hues, and vibrant colors.

Pick up any fungal flower and inspect it at close hand, observing its many interesting features, its shape, color, odor, and texture. Turn it over to learn if it has gills, pores, or spines under the cap. Use a 10X hand lens to see even more!

Your enjoyment of the flowers need not be limited to the green, vascular plants. The fungal flowers are equally interesting, fascinating, beautiful, and enjoyable.

Believe the motto of the North American Mycological Association, "There's a world of wonder at your feet!"

List of Abbreviated Names of Authors of Fungi:

Berk. = J.M. Berkeley
 Bolt. = Bolton
 Br. = C. Broome
 Bull. = P. Bulliard
 Fr. = E.M. Fries
 Huds. = W. Hudson
 Kauf. = C. Kauffman
 Kuehn. = R. Kuehner
 L. = Carolus Linnaeus
 Mass. = G. Massee
 Mull. = O.F. Muller
 Murr. = W.A. Merrill
 Pers. = C.H. Persoon
 Schaeff. = J.C. Schaeffer
 Schw. = L.D. Schweinitz
 Scop. = J.A. Scopoli

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Russula emetica

Is There a Drip In Your Future?

Pandora Wilson

About 40 years ago, Symcha Blass, an Israeli engineer, noticed something unusual: trees planted near a dripping faucet grew more rapidly, were more vigorous, and matured earlier than those not similarly situated. He translated his observations into the first patented, practical modern trickle irrigation system. It was the rapid development and proliferation of the plastics industries after World War II with the resultant economical manufacture of chemically resistant water lines of small diameter, which made these systems practical.

The concept of trickle irrigation is not new. Records of various attempts at such systems run back into ancient history, when the Mesopotamians purportedly irrigated vegetables with water dripped through perforated hollow reeds. In the 1890s German farmers buried clay pipes with open joints in an effort to combine irrigation with drainage, and in the 1930s Australian growers with

limited water supplies tried galvanized pipes into which holes had been chiseled. British greenhouse growers tried similar methods in 1948.

The first commercial drip irrigation systems in the U. S. were introduced into California, Hawaii, and Texas in 1968 to solve problems of rising labor costs, power costs, and water shortages. These systems proved valuable where high water salinity or 60 degree slopes made normal irrigation methods impossible. Much marginal land was brought into production through this new method of irrigation.

In an increasingly conservation-conscious world, faced with shortages of energy and natural resources, trickle or drip irrigation has been proposed as one means by which the efficiency of irrigation may be improved and the productivity of land increased.

Just what is drip irrigation, and how does it work? Drip or trickle irrigation is best defined as the controlled application of water at a very low rate to the root zone of the plant. The idea is to water every day, or every third day, but not too much at a time — replacing only the moisture that the plant uses every day. By confining the wetted area to the root

Mrs. Pandora Wilson is an Advanced Master Gardener volunteer working with the Denver office of the Co-Operative Extension Service, U.S. Department of Agriculture.

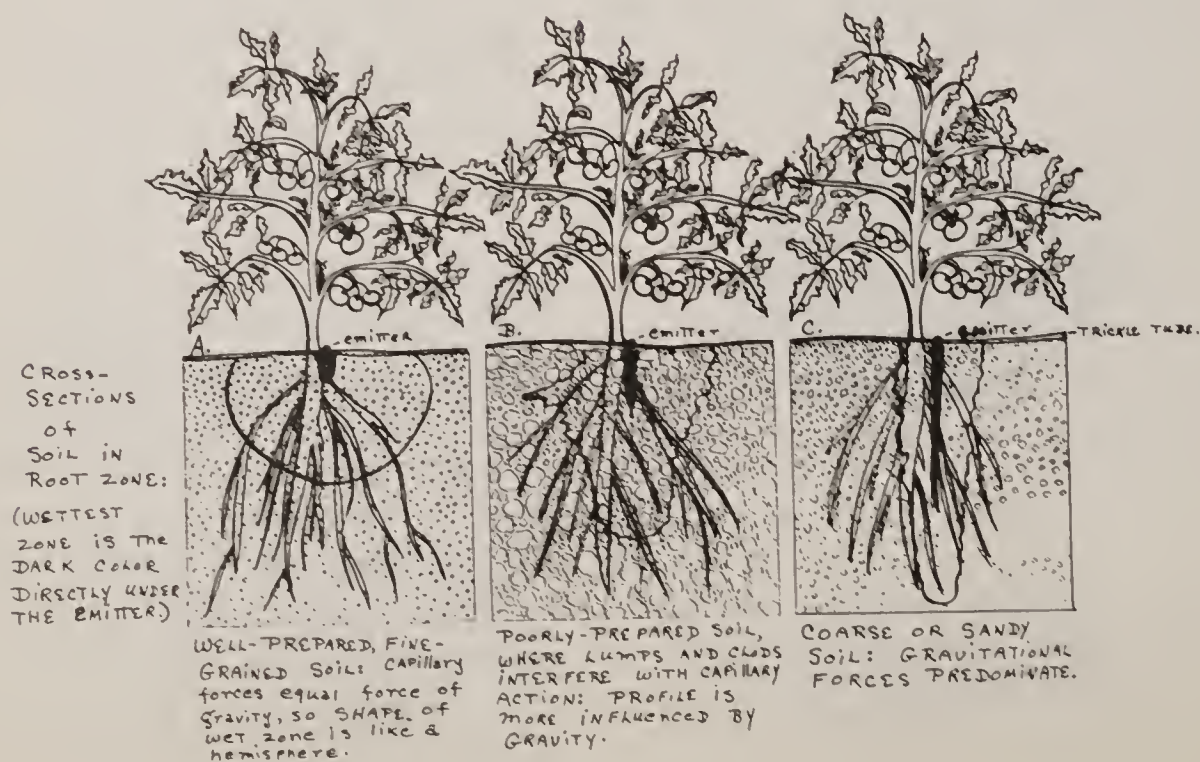
zone of the plant, there is a significant saving in water; diseases and fungi are not spread so readily (because the foliage is kept dry), and nutrients are not leached so easily from the soil. Paths and other areas between plants are not wet, so harvesting is easier and excess water evaporation is reduced. And since the whole area is not saturated, there are fewer weeds encouraged and the ground temperature is increased — causing still greater plant growth.

The saving in water is related to the inefficiency of the older method used — because the water utilized by the crop is the same in either case. As an example for comparison, flood irrigation can waste up to one-half the water applied.

Since the soil moisture is maintained at a more uniformly high level, moisture stress to plants is prevented, rather than corrected as in other methods. This promotes larger yields, more uniform and uninhibited growth of crops, and earlier maturity.

Drip irrigation may be used on a wide variety of soils under many topographical conditions. Frequent irrigation at a slow rate has some advantages in soils that are shallow or tight, or have some other restrictive characteristic, bearing in mind that the aeration period between waterings on a clay soil may be 12 hours or more. The rapid water loss characteristic of a sandy soil can be overcome by the frequency of irrigation used. Rapid runoff of water from precipitous slopes is corrected by the slow frequent applications of water from drip irrigation. In the case of a high-saline water source, keeping the root zone wet at all times tends to drive concentrated salts to the periphery of this zone. This serves to protect the roots, but it also produces a heavy accumulation of salts in the boundary zone which must be periodically leached away. Rainfall tends to redistribute salts back into the root zone, so systems with high-salinity water must be run at sufficient pressures during rainfall to counteract this effect.

SOIL COMPOSITION AND TEXTURE AFFECTS SHAPE OF WETTING PATTERN:



When fertilizer injectors are used in conjunction with these systems, more accurate delivery of nutrients is possible and loss through deep percolation is eliminated as well as waste between rows. This lessens environmental problems due to the contamination of underground water by agricultural chemicals. Fertilizer "burn" of roots is eliminated because nutrients are greatly diluted by the irrigation water.

In commercial agriculture, money spent on power and equipment is reduced in comparison to other systems such as sprinkler and furrow, because less power is required to pump at the lower pressures needed, and lighter gauge hardware can be used. Automated systems save greatly in manpower and time.

Careful Management Needed

There are also certain disadvantages in employing trickle systems. Their efficiency depends greatly on how well the particular system is managed and monitored. Plugging of emitters and lines is an important concern, and the system should be back-flushed when needed, to prevent this. Filters must be cleaned. The success of the drip system depends heavily on the even distribution of water to each plant. Newer improved emitter designs have helped greatly with this problem. If effluent or well water is used, chlorination at 10 ppm for 20 min. per day may be necessary to prevent fungal or bacterial growth. If city water is used, an antisiphon valve may be required. Water in this area also contains high levels of mineral salts which tend to form deposits which may clog the emitter holes as the water

evaporates. Fertilizer injectors should always precede filters.

The tubing is subject to vandalism, ants, rodents sharpening their teeth, and inadvertent wielding of shovels and hoes. These accidents are easily mended however with repair couplings and waterproof plastic tape.

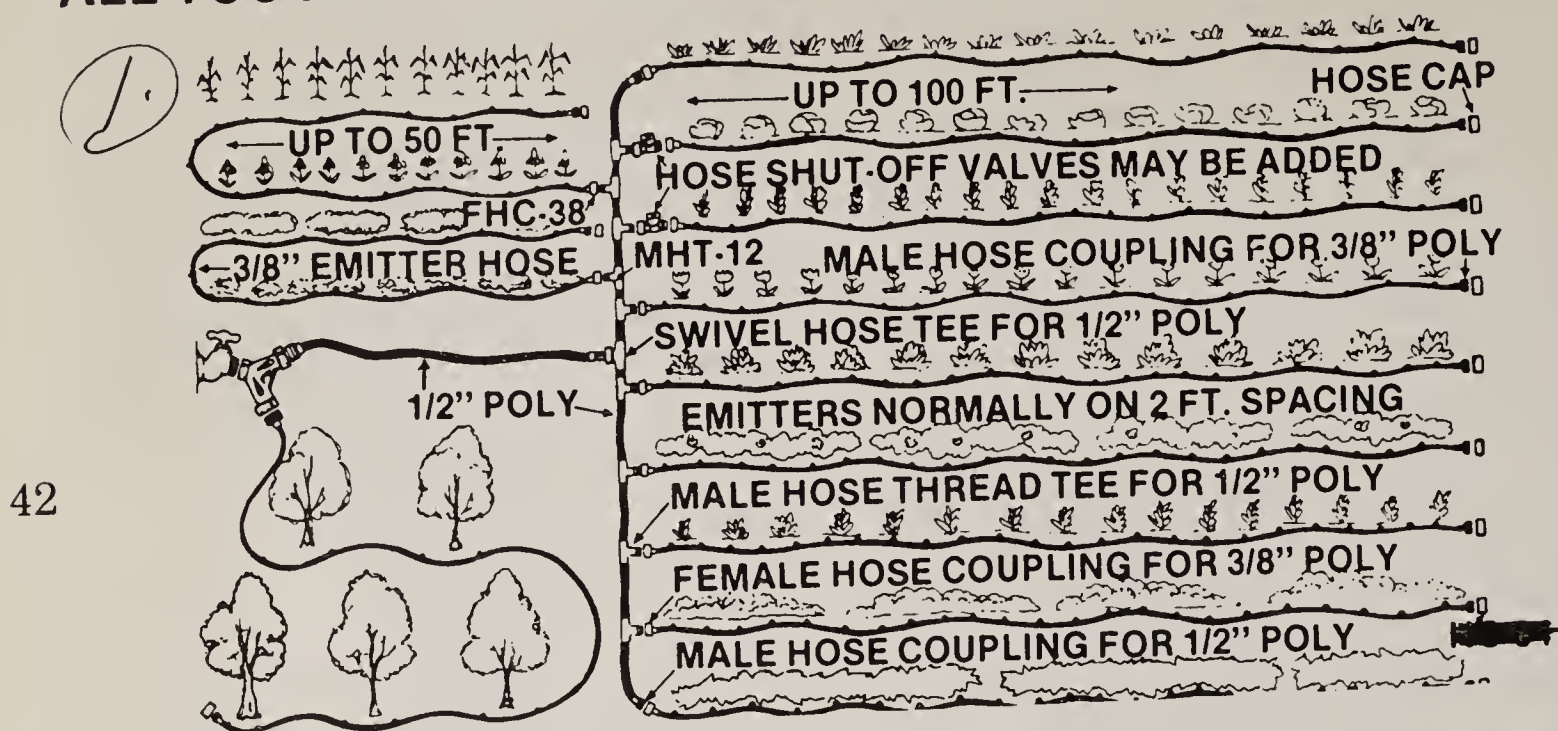
If the system is an above-ground one such as for a vegetable plot, it must be removed and stored in the fall so that the soil can be prepared. If it is one which is installed below ground, it must be drained for the winter.

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In order to make these systems work, close attention must be paid to such factors as moisture requirements of the plant, amounts of moisture in the root zone, soil evaporation rates, and soil texture and wetting profiles. This is because frequent applications of small metered amounts of water (as opposed to the longer-interval application of excess water, as in older systems of irrigation) results in the soil no longer serving as a moisture reservoir. Clay soil, especially, must not be allowed to dry out to the point of cracking, as this interferes with the proper conduction of water through the soil. Wetting profiles differ according to the type of soil: sandy soils with coarse texture drain rapidly and have a narrow, carrot-shape profile; loam soils have a medium shape, such as a pear; and clay soils, with the smallest particle size and pore spaces, take water more slowly, hold it longer, and have the widest wetting shape of all soils — like an onion. This maintenance of an ideal balance of soil moisture, oxygen content, and nutrients so that optimum plant growth occurs is called "field capacity". It is a radical departure from other systems of watering.

DRIP IRRIGATION KIT FOR HOME GARDENS

ALL YOU NEED FOR TEN 50 FT. GARDEN ROWS—AND MORE!



Useful for Average Homeowner

In spite of these drawbacks, the advantages of this method of watering have begun to trickle down to the average homeowner in the form of relatively inexpensive kits and simplified do-it-yourself systems and parts. The beauty of these kits is that almost anyone with a sharp knife and a pair of pliers can put one together. The beastly factor is that the better, larger, more complicated and automated systems offered are still a lot more expensive than the average homeowner is willing to pay. These could be as expensive as the price of a good automated lawn sprinkling system (including labor in both cases), the difference being that it is possible to buy components of the trickle systems a few at a time, adding to them as needed.

Cost of kits in this area can vary from about \$15.00 for 50 ft. of simple little soaker hose, \$35.00 for

a bit more elaborate ones, to about \$135 for 500 ft. plus feeder line, of emitter hose, T couplings, end caps, emitters, insert tool, and filter. Accessories, such as timers, antisiphon valves, solenoids, pressure reducers, pressure gauges, flow control valves, gate valves, and fertilizer injectors are sold separately and can make a drip system more accurate, convenient, automatic, time-saving, and considerably more expensive. Some sprinkler companies in the metro area now offer custom-designed drip systems for either ornamental and shrub borders or for vegetable gardens.

Sources of systems and parts are plastic pipe companies, pump companies, sprinkler services, greenhouse distributors, and irrigation companies. The small kits are carried by many local nurseries and garden shops. Many vegetable and general nursery catalogs (mail order) also carry them. For information about local sources of equipment and pertinent literature, call your County Extension Agent.

The Jefferson County Master Gardeners grow a demonstration garden at the Jefferson County Fairgrounds, on 6th Ave. at Indiana, which features a drip irrigation system. It is a spot system, which consists of a combination of monotubing for row crops, and emitter tubing with vortex emitters for tomatoes, squash, peppers, and eggplants. Monotubing forms a spray pattern for germination of seeds, and later additions of mulch spread the pattern over the root zones. Wide-row plantings of other vegetables form a canopy mulch with overlapping leaves. A water meter, pressure reducer, pressure gauges, fine-mesh filters, and gate valves make this system a very usable one. The pressure recommended for use with this system is 15 to 20 psi. Interested gardeners are invited to get in touch with the Colorado State University Extension agent in Jefferson County (279-4511) to tour the garden during the growing season.

Plans are being made by the Denver C.S.U. Extension Office for a demonstration garden which it is hoped will feature another of the trickle systems.

Here's How To Put A Drip Together:

Types of Tubing and Emitters:

Most drip line tubing is 3/8 inch or 1/2 inch in diameter. Most emitter tubing is 1/8 inch in diameter. This may consist of polyethylene or polyethylene plus rubber, which has been treated to withstand ultraviolet light and stress cracking. Most submains



Drip System in Use

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are PVC tubing. Emitter-hose has holes spaced at regular intervals and can be single- or double-walled; or it can be a soaker type, with water seeping along the entire length of the tube. This is used mainly for row crops. Emitter drip tube is circular in cross-section and while still flexible, does not depend upon water pressure to hold its shape. In emitter tubing emitters are inserted at intervals along its length. A variation of this emitter tubing is called spaghetti tubing; it is used to water individual containers. The length of the tubing and the pressure determine how much water is given to each plant.

There are various designs of emitters from which to choose depending upon the needs of your system, the plants you are growing, the soil type, the grade or elevation, and the design and purpose of your planting. Pressure compensating emitters, for example, help a drip system to go uphill without undue losses in pressure. All emitters serve the purpose of slowing down the application rate of water. The ideal is to have the last emitter at the end of the system emitting at the same rate of flow as the emitter nearest the water source.

The commonest emitter used discharges at a rate of 1 gallon per hour.

Accessories

44 Systems can be completely automated with solenoid valves, timers, and tensiometers that turn the system on and off at the proper moisture levels. The best accessories have garden hose threads, which make it easy to add or remove any item without the aid of special tools. These may include items such as valves, tees, strainers, filters, pressure gauges, fertilizer applicators, pressure regulators, flow controls, and so forth.

Dripper Spacing

Dripper spacing is determined by the water needs of the plant, the aeration time, and the discharge rate of the emitter. Factors determining the needs of a crop have been the subject of great study and formulae have been devised to determine the needs of various types of plants. A good reference text is *Soil-Plant Relationships* by C. A. Black, published by Wylie and Sons, Inc.

There are some simpler methods to determine if your system will work well for the purpose of covering the root zone: since an average of about 40% of the root zone of the plant needs to be kept moist, dripper spacing and placement is important. Allow a dripper to discharge in the specific spot of the planting area until moisture reaches the desired root depth. Turn the water off and dig a trench 12 inches deep through the wetted area. It has been determined that 80% of the total moist

area at that one foot level is due to the dripper spacing. Does the pattern and shape of the area correspond to your expected root area? If not, move the dripper spacing. It is easier to determine flow rates where plant spacings and emitter spacings are regular.

In planning the drip system, it is important to determine how much area can be watered by a certain length of tubing. With emitters spaced every two feet, for example, each 100 foot length of hose will use about 1 gallon of water per minute. If in doubt about how much water flow you have, see how long it takes to fill a 1 gallon container at the end of the garden hose. If it takes 10 seconds, then you have about 6 gallons per minute, which is the average for an outside water tap. This should be adequate for up to six 100 foot lengths of hose. If more is needed, divide the system into two or more sets, with only one set used at a time.

The irrigation time interval is dependent on the flow rate through an emitter. The flow rate depends upon the system's operating pressure. Suppose a particular emitter has a flow rate of 1 gallon per hour at a pressure of 10 pounds per square inch (psi). If a tomato plant requires 2 gallons a day, for example, you may water for 2 hours, or for 1 hour at two different times during the day. The time needed to water each period will vary, but could possibly range from 10 minutes on cooler days to 1 hour at the peak of the growing season. Longer intervals between waterings would require longer periods of watering each time; as for example, when you are trying to stay within the 3-day watering restrictions of the Denver water

board. Although this is admittedly less efficient (and does not save any water over the shorter time intervals), using this particular system, it still can be done handily. With each emitter dripping one gallon per hour and covering an area of 3 square feet, the application rate will be approximately 1/2 inch of water per hour — the same as 1/2 inch of rain.

If you wish to study the amount of daily evaporation loss in your area, there is a correlation between the amount of water evaporated into the atmosphere and the amount of water used by plants. Replacing 70% of the water that is evaporated each day should be adequate for most plants. Tensiometers that measure the soil moisture are also helpful.

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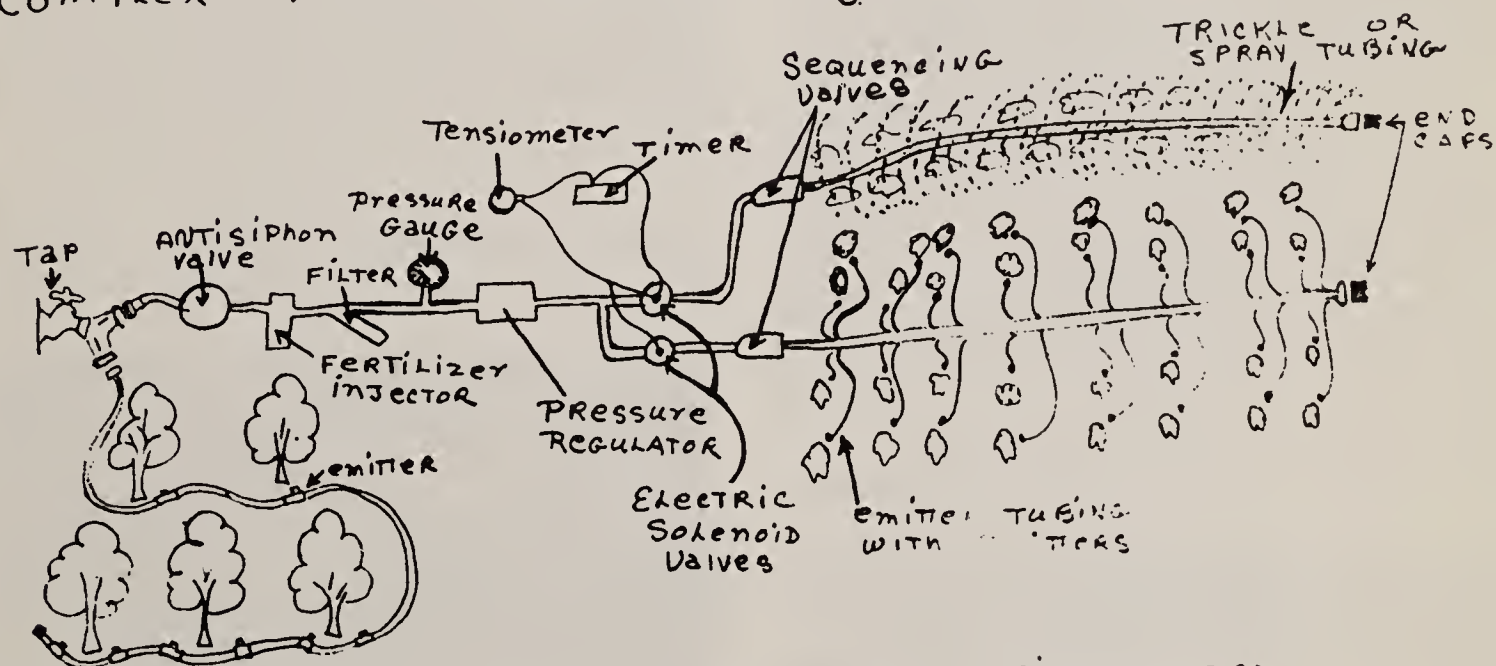
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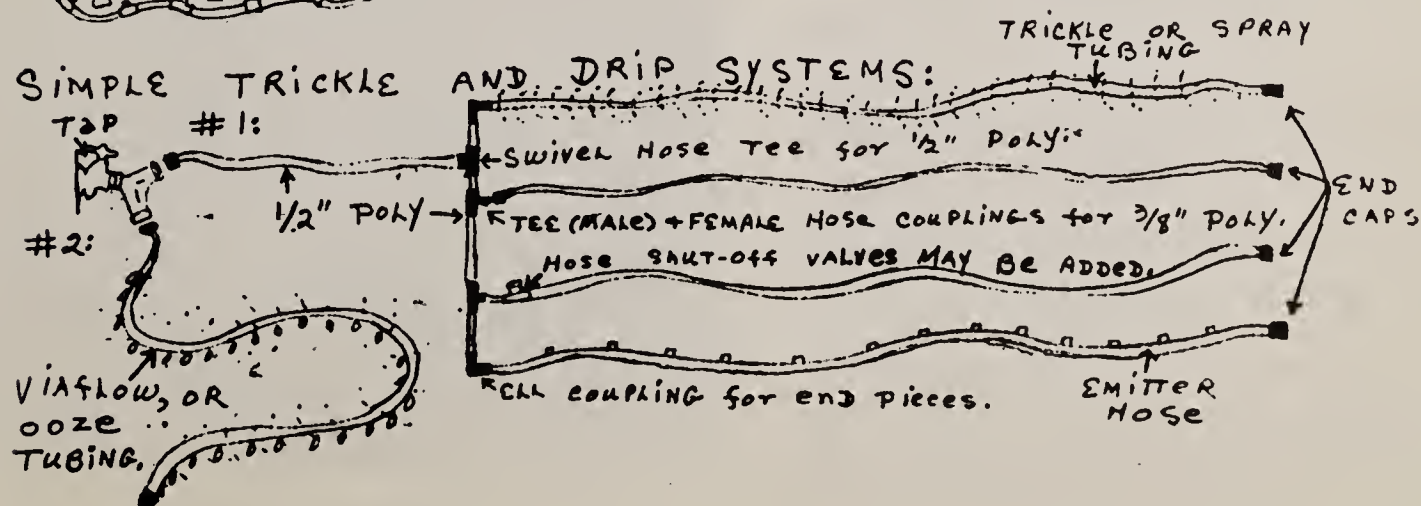
Soak N'Spray obtained through Burpee Seed Co., Clinton, Ia. 52732.

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COMPLEX TRICKLE AND DRIP SYSTEM:



SIMPLE TRICKLE AND DRIP SYSTEMS:



Focus on

Eugenia and *Syzygium*

in the

Boettcher Memorial Conservatory

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Peg Hayward

Eugenia L. was originally considered the largest genus of trees and shrubs, comprising about 2000 species. This confusing group of myrtaceous evergreens was found in both hemispheres. Taxonomists in recent years, because of the complexities, split the genus into two main groups plus some smaller general. Generally speaking the genus *Eugenia*, named in honor of Prince Eugene of Savoy, a patron of botany and horticulture, now includes 1,000 or more species of the New World and the genus *Syzygium* Gaertn. comprises most of the Old World plants with 400-500 species. However, horticulturists have been slow to accept this switch in nomenclature.

Plants representing both genera are in the Boettcher Memorial Conservatory collection. Few *Eugenias*, New World species, are distinguished as pretty flowering trees, but bear delightful edible fruits. *Eugenia uniflora* L. has several common names including

Surinam cherry, Barbados cherry, Brazilian cherry, pitanga, and others. It is uncertain where the name Surinam came from because the plant did not originate in Dutch Guiana but is native to Brazil. This is a compact shrub or small tree with 2-inch long, oval, pointed leaves. The new leaves are red which is common in *Eugenias* as well as some other tropical trees. The red immature foliage results when pigments known as anthocyanins occur dissolved in the cell sap before the chlorophyll is developed. The coloration is often so vivid that from a distance trees appear to be in bloom. The Surinam cherry has creamy white,



Eugenia uniflora

Mrs. Peg Hayward's long association with the Boettcher Conservatory enables her to write about the plants housed there. "Focus on" has been a regular feature of *The Green Thumb* for several years.



Syzygium jambas

slightly fragrant flowers with prominent stamens. The distinctive eight-grooved, 1-inch cherries are first green, then yellow, orange, and finally crimson. When fully ripe they have a delightful aromatic flavor and may be eaten out of the hand or used in making jellies, sherbets, and mixed drinks.

Eugenia paniculata Banks var. *australis* Wendl. is one of the plants about whose correct name botanists have had much discussion. Undoubtedly there is a wide variation in the species. The Australian brush cherry is a cone shaped tree up to 50 feet. Its leaves are attractive glossy green and the pure white, fluffy flowers are striking. Oval deep red fruits of good size hang on all fall and winter. It is cultivated in California and Florida as a background hedge and for topiary work. The fragrant fruit may be used for jelly.

Syzygium jambos Alston (*Eugenia jambos* L.), rose apple, a dense

evergreen Malayan shade tree is cultivated for its handsome form, showy, fragrant flowers, and fruit. Greenish-white, powderpuff flowers are 2 inches across. Four or five petals are visible in the bud stage but are almost obscured later by the mass of stamens. The fruit is nearly round, 2 inches wide, pale yellow with sepals still clinging over a depression at the tip. The flesh of the fruit is dry and crisp with a rose scent and taste which persist even when made into jelly.

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Syzygium malaccense (L.) Merrill and L. M. Perry, Malay apple, is not in the Boettcher Memorial collection but noteworthy because it is considered one of the tropics' most beautiful flowering trees. When in bloom, magenta brush-like flowers burst from the trunk and branches and as the pompons fall, a bright carpet is laid on the ground below. Also, among this heterogeneous group of plants is *Syzygium aromaticum* (L.) Merrill and L. M. Perry, clove, the commercial spice from the Moluccas. Cloves are the sun-dried flower buds. the name is an adaptation of the French *clou* (nail) and refers to the shape of the flower buds.

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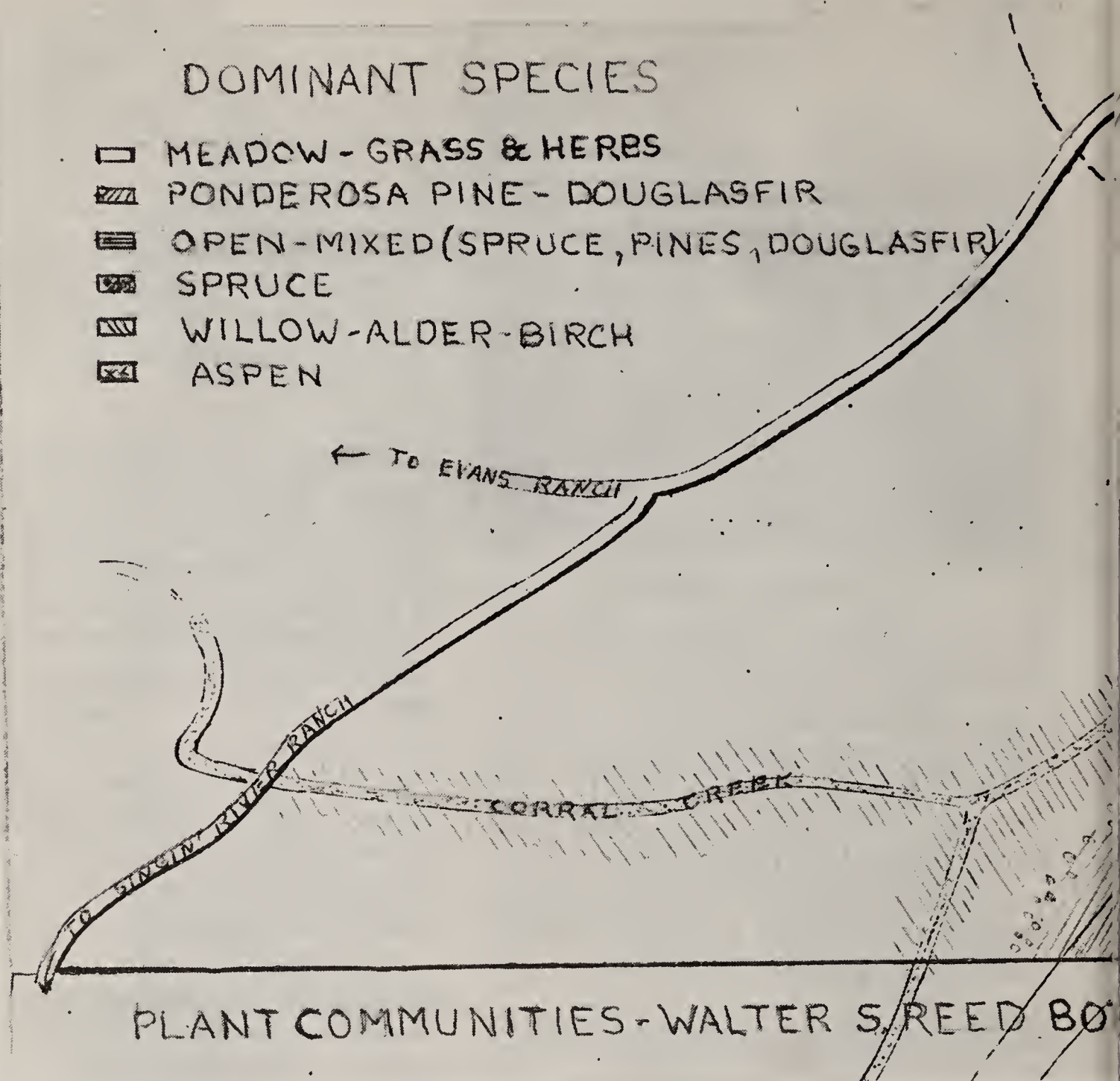
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WALTER S. REED BOTANIC GARDEN

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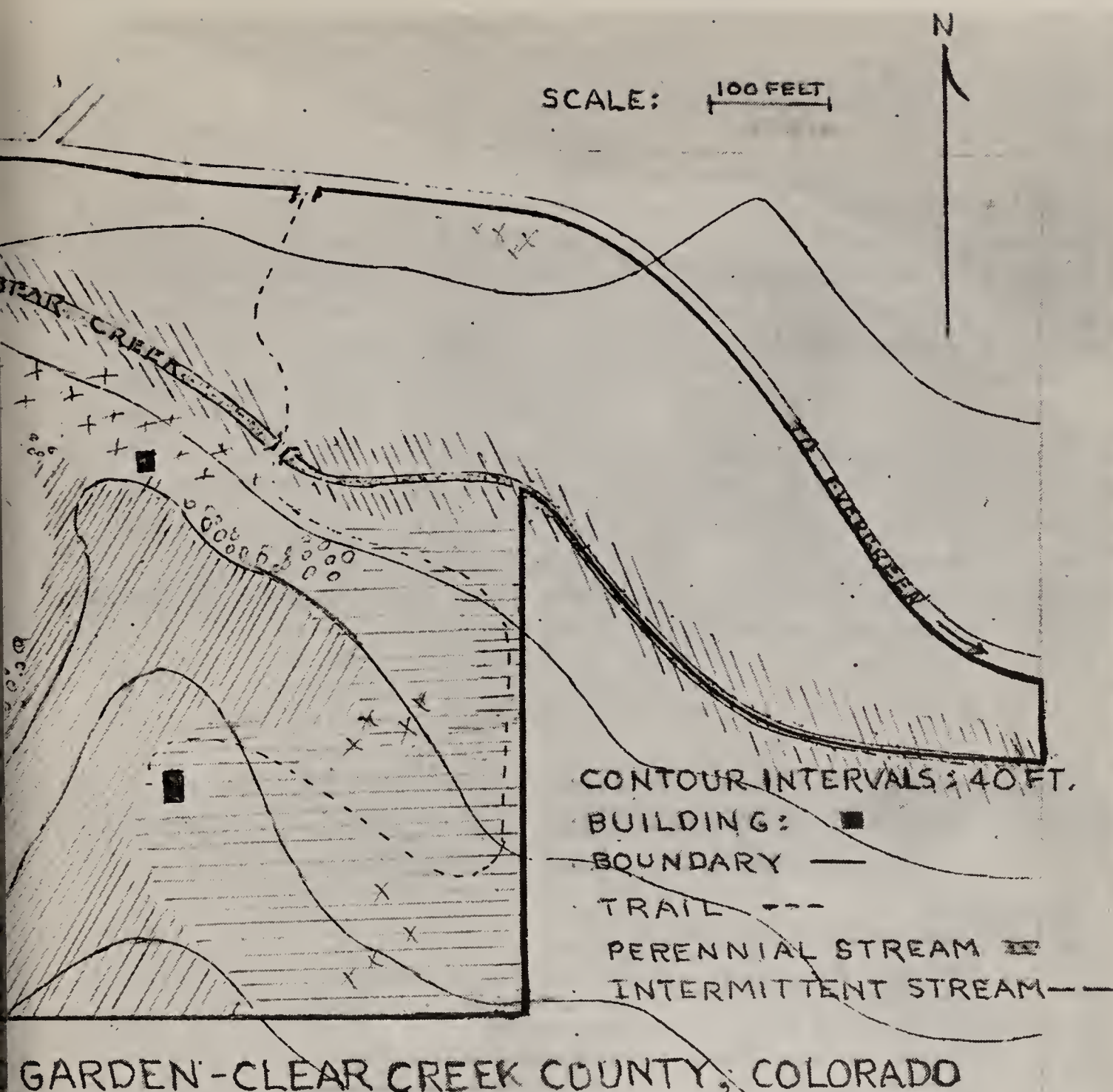
Velma Richards

The founders of the Denver Botanic Gardens visualized a Botanic Garden which would include a series of life-zone study areas in the Front Range of the Rocky Mountains and the adjacent Denver Region. This vision has become a reality with the Mount

Goliath Alpine unit, the Chatfield Dam foothills-plains site, and the Walter S. Reed Botanic Garden in the montane zone near Evergreen.

This latter unit, a legacy from the late Mrs. Walter S. Reed, is perhaps the least known of these study-areas. It is a plot of some twenty acres in Upper Bear Creek Canyon at an altitude of 7500' - 7650' through which Bear Creek runs. The broader ridge-tops surrounding the area are in the 8000' - 9000' range placing the area within the altitudinal range of the upper montane climax forest

Mrs. Velma Richards has been a Science Technician in the Cherry Creek School District. Her study of the flora at the Walter Reed Garden evolved from a long time interest in botany and was part of an ecology project at the Arapahoe Community College.



region. It is generally a north-facing slope with a valley floor through which the creek runs — a spreading and relatively slow stream resultant from beaver activity at one end to a narrowed and more rapid body at the other.

Although the area is relatively small, its specific topographic features present an abundance of variable micro-habitats each with its unique plant communities — a real treasure chest for the botanical explorer.

The members of the Around the Seasons Club were given the

pleasure of opening the treasure chest in the summer of 1974, when many hours were spent discovering the unusual as well as the commonplace features that were present. A closer scrutiny often revealed the real treasures — the beady, black-dotted, golden petals of St. Johnswort; the anise fragrance of *Aletes anisatus* Gray; the emerging brown heads of the pine drops; the leathery green rosettes of the snowball saxifrage; the pendant catkins of the alder and the aspen; the spiral siliques of the twisted-pod draba; the exquisite structure of the unfolding calyx of the valerian. As with

any plant community the scene is a dynamic one, where variation in ecological factors brings changes which often reveal new treasures to the observer with each succeeding visit to the area.

This original effort plus subsequent perusals by other interested persons has resulted in the following checklist of plants found in the Walter S. Reed Botanic Garden.

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Mr. and Mrs. Reed acquired the property between 1917 and 1924. Both natives of Iowa, they enjoyed the outdoors and especially enjoyed riding horseback up the scenic valley toward Mount Susan.

A graduate of the University of Colorado, Mr. Reed taught history, economics, social studies, and served as counselor at East High School from 1904 until retirement in 1936. Ruth Wallace Reed, also a teacher in the Denver Public Schools for more than 30 years, was a graduate of the University of Denver and taught English at East, chemistry at North, and later taught general science and mathematics on the junior high school level at Cole and Smiley. He died in 1958 and she in 1963. It is in accordance with her wish that this gift to Denver Botanic Gardens was established in memory of her husband, Walter S. Reed.

A Preliminary Check-List of Vascular Plants at Walter S. Reed Botanic Garden, Evergreen, Colorado (Compiled by Velma Richards)

Division: Pteridophyta

EQUISETACEAE (Horsetail family)

Equisetum arvense L. — Field horsetail

E. variegatum Schleich. — Variegated scouring rush

SELAGINELLACEAE (Little club-moss family)

Selaginella densa Rydb. — Rock selaginella

Division: Spermatophyta

Subdivision: Gymnospermae

PINACEAE (Pine family)

Juniperus communis L. — Common juniper

J. virginiana L. var. *scopulorum* Lemmon — Red cedar

Picea sp. — Spruce

Pinus contorta Dougl. var. *latifolia* Englm. — Lodgepole pine

P. ponderosa Laws. var. *scopulorum* Engelm. — Ponderosa pine

Pseudotsuga menziesii (Mirb.) Franco — Douglas-fir

Subdivision: Angiospermae — Class: Dicotyledoneae

ACERACEAE (Maple family)

Acer glabrum Torr. — Mountain maple

AMARANTHACEAE (Amaranth family)

Amaranthus retroflexus L. — Rough pigweed

APOCYNACEAE (Dogbane family)

Apocynum androsaemifolium L. — Spreading dogbane

BETULACEAE (Birch family)

Alnus tenuifolia Nutt. — Alder

Betula occidentalis Hook. — River birch

BORAGINACEAE (Borage family)

Cryptantha virgata (Porter) Payson — Miners candle

Hackelia floribunda (Lehm.) Johnston — Stickseed

Mertensia lanceolata (Pursh) A. DC. — Narrow-leaved mertensia

M. ciliata (James) G. Don — Tall chiming bells

- CAMPANULACEAE (Bellflower family)
Campanula parryi Gray — Harebell
C. rotundifolia L. — Common harebell
- CAPRIFOLIACEAE (Honeysuckle family)
Lonicera involucrata (Rich.) Banks ex Spring. — Bush honeysuckle
Symphoricarpos occidentalis Hook. — Snowberry
- CARYOPHYLLACEAE (Pink family)
Cerastium vulgatum L. — Common mouse-ear
Melandrium dioicum (L.) Coss & Germ. — White campion
Moehringia lateriflora (L.) Fenzl.
Stellaria longifolia Muehl. ex Willd. — Starwort
- CHENOPODIACEAE (Goosefoot family)
Chenopodium album L. — Lamb's quarters
C. capitatum (L.) Asch. — Strawberry blite
- COMPOSITAE (ASTERACEAE) (Sunflower family)
Achillea lanulosa Nutt. — Yarrow
Agoseris glauca (Pursh) Raf. — False dandelion
Ambrosia trifida L. — Giant ragweed
Antennaria parvifolia Nutt. — Pussytoes
Antennaria rosea Greene — Pink pussytoes
Arnica cordifolia Hook. — Heart-leaved arnica
Artemisia campestris L. ssp. *caudata* (Michx.) Hall & Clements
A. frigida Willd. — Pasture sagebrush
A. ludoviciana Nutt. — Prairie sage
Aster bigelovii Gray — Sticky aster
Aster laevis L. — Smooth aster
Aster porteri Gray
Brachyactis angusta (Lindl.) Britt.
Carduus nutans L. ssp. *macrolepis* (Peterm.) Kazmi — Musk thistle
Cirsium arvense (L.) Scop. — Canada thistle
Cirsium vulgare (Savi) Tenore — Bull thistle
Crepis runcinata T & G — Hawkweed
Erigeron compositus Pursh — Daisy
E. elatior (Gray) Greene — Fleabane
E. flagellaris (Gray) — Trailing fleabane
E. speciosus (Lindl.) DC var. *macranthus* (Nutt.) Cronq. —
Showy Daisy
E. vetensis Rydb. — La Veta daisy
Gaillardia aristata Pursh
Grindelia squarosa (Pursh) Dunal. — Gumweed
Gymnolomia multiflora (Nutt.) Benth. & Hook.
Helianthus rigidus (Cass.) Dest. var. *subrhomboides* (Rydb.)
Heiser
Heterotheca villosa (Pursh) Shinnars — Golden Aster
Lactuca scariola L. — Prickly lettuce
Rudbeckia hirta L. — Black-eyed Susan
R. laciniata L. var. *ampla* (Nels.) Cronq. — Tall coneflower
Senecio integerrimus Nutt.
S. pseud aureus Rydb.
S. pudicus Greene
Solidago missouriensis Nutt. — Smooth goldenrod
Taraxacum sp. — Dandelion
Tragopogon pratensis L. — Meadow salsify
- CONVOLVULACEAE (Morning-glory family)
Convolvulus arvensis L. — Small bindweed
- CRASSULACEAE (Stonecrop family)
Sedum lanceolatum Torr. — Stonecrop
- CRUCIFERAE (BRASSICACEAE) (Mustard family)
Arabis drummondii Gray — Rock cress
A. fendleri (Wats.) Greene — Rock cress
Barbarea orthoceras Ledeb. — Winter cress

- Camelina microcarpa* Andrz. — False flax
Capsella bursa-pastoris (L.) Medic — Shepherd's purse
Cardamine cordifolia Gray — Bitter cress
Descurania richardsonii (Sw.) O. E. Schultz —
Western tansy mustard
Descurania sophia (L.) Webb — Flixweed
Draba aurea Vahl — Golden draba
D. streptocarpa Gray — Twisted pod
Erysimum asperum (Nutt.) DC. — Western wallflower
Lesquerella montana (Gray) Wats. — Mountain bladderpod
Rorippa sphaerocarpa (Gray) Britt. — Cress
Sisymbrium altissimum L. — Jim Hill mustard
Thlaspi alpestre L. — Wild candytuft
Thlaspi arvense L. — Penny-cress
ELEAGNACEAE (Oleaster family)
Shepherdia canadensis (L.) Nutt. — Buffalo berry
ERICACEAE (Heath family)
Arctostaphylos uva-ursi (L.) Spreng. — Kinnikinnik
Pterospora andromedea Nutt. — Pine drops
Ramischia secunda (L.) Garcke — One-sided wintergreen
EUPHORBIACEAE (Spurge family)
Euphorbia robusta (Engelm.) Small — Rocky Mountain spurge
FUMARIACEAE (Fumitory family)
Corydalis aurea Willd. — Golden smoke
GENTIANACEAE (Gentian family)
Frasera speciosa Dougl. — Monument plant
GERANIACEAE (Geranium family)
Erodium cicutarium (L.) L'Her. — Filaree
Geranium fremontii Torr. — Common wild geranium
G. richardsonii F. & T. — White geranium
GROSSULARIACEAE (Gooseberry family)
Ribes cereum Dougl. — Wax currant
R. inerma Rydb. — Common gooseberry
R. lacustre (Pers.) Poir. — Prickly currant
HYDRANGEACEAE (Hydrangea family)
Jamesia americana T. & G. — Waxflower
HYDROPHYLLACEAE (Waterleaf family)
Hydrophyllum fendleri (Gray) Heller — Waterleaf
Phacelia heterophylla Pursh. — Scorpion-weed
HYPERICACEAE (St. Johnswort family)
Hypericum formosum H. B. K.
LABIATAE (**LAMIACEAE**) (Mint family)
Lamium amplexicaule L. — Henbit
Mentha arvensis L. — Field mint
Moldavica parviflora (Nutt.) Brett. — Dragonhead
Monarda fistulosa L. var. *menthaefolia* (Graham) Fern. —
Pink bergamot
Prunella vulgaris L. — Heal-all
Scutellaria brittonii Porter — Skullcap
Stachys palustris L. — Hedgenettle
LEGUMINOSAE (**FABACEAE**) (Pea family)
Astragalus alpinus L. — Alpine milk vetch
A. parryi Gray — Parry milk vetch
Lupinus argenteus Pursh — Common lupine
Oxytropis lambertii Pursh — Colorado loco weed
Thermopsis divaricarpa Nels. — Golden banner
T. montana Nutt. — Golden banner
Trifolium pratense L. — Red clover
T. repens L. — Creeping clover or White Dutch clover
Vicia americana Muehl. — Vetch
MALVACEAE (Mallow family)
Malva neglecta Wallr. — Cheeseweed
ONAGRACEAE (Evening primrose family)
Epilobium angustifolium L. ssp. *circumvagum* Mosquin —
Fireweed

- E. glandulosum* Lehm. — Northern willow-herb
Oenothera coronopifolia T. & G. — Cut-leaf evening primrose
O. strigosa (Rydb.) Mack & Bush — Common evening primrose
 OXALIDACEAE (Wood sorrel family)
Oxalis dillenii Jacq. — Wood sorrel
 PLANTAGINACEAE (Plantain family)
Plantago major L. — Plantain
 POLEMONIACEAE (Phlox family)
Collomia linearis Nutt.
Microsteris gracilis (Dougl.) Greene
Polemonium foliosissimum Gray — Leafy Jacob's ladder
 POLYGONACEAE (Buckwheat family)
Bistorta bistortoides (Pursh) Small — Bistort
Eriogonum umbellatum Torr. — Sulphur-flower
Fallopia convolvulus (L.) A. Love — Black bindweed
Rumex acetosella L. — Sheep sorrel
R. crispus L. — Curly dock
 PRIMULACEAE (Primrose family)
Androsace septentrionalis L. — Rock primrose
Dodecatheon pulchellum (Raf.) Merrill — Shooting star
 RANUNCULACEAE (Buttercup family)
Aconitum columbianum Nutt. — Monkshood
Actaea rubra (Ait.) Willd. — Baneberry
Anemone canadensis L. — Meadow anemone
A. cylindrica Gray — Thimble weed
A. multifida Poir. var. *globosa* (Nutt.) T. & G. — Globeflower
Aquilegia caerulea James — Colorado blue columbine
Clematis pseudoalpina (Kuntze) Nelson — Rocky Mountain
clematis
Delphinium ramosum Rydb. — Larkspur
Pulsatilla patens (L.) Miller ssp. *multifida* (Pritzel) Zamels —
Pasque flower
Ranunculus inamoenus Greene — Homely buttercup
Ranunculus trichophyllus Chaix. — Water crowfoot
Thalictrum fendleri Engelm. — Meadow rue
Trollius laxus Salisb. var. *albiflorus* Gray — Globeflower
 ROSACEAE (Rose family)
Amelanchier alnifolia Nutt. — Common shadbush
Cercocarpus montanus Raf. — Mountain mahogany
Fragaria ovalis (Lehm.) Rydb. — Strawberry
Geum allepicum Jacq. — Yellow avens
Pentaphylloides floribunda (Pursh) A. Löve — Shrubby cinquefoil
Physocarpus monogynus (Torr.) Coult. — Ninebark
Potentilla anserina L. — Silverweed
P. arguta Pursh — Sticky cinquefoil
P. fissa Nutt. — Leafy cinquefoil
P. gracilis Dougl. ex Hook. — Soft cinquefoil
P. pulcherrima Lehm. — Beauty cinquefoil
Prunus virginiana L. var. *melanocarpa* (A. Nels.) Sarg —
Chokecherry
Rosa woodsii Lindl. — Rose
Rubus deliciosus James — Boulder raspberry
R. idaeus L. — Wild red raspberry
 RUBIACEAE (Madder family)
Galium boreale L. — Northern bedstraw
 SALICACEAE (Willow family)
Populus tremuloides Michx. — Quaking aspen
Salix spp.
 SAXIFRAGACEAE (Saxifrage family)
Heuchera bracteata (Torr.) Ser. — Bracted alumroot
H. parvifolia Nutt. — Common alumroot
Saxifraga rhomboidea Greene — Snowball saxifrage
S. bronchialis L. — Spotted saxifrage

SCROPHULARIACEAE (Figwort family)

- Castilleja integra* Gray — Orange paintbrush
C. linariaefolia Benth. — Wyoming paintbrush
C. miniata Dougl. — Scarlet paintbrush
C. sulphurea Rydb. — Yellow paintbrush
Linaria vulgaris Mill. — Butter-and-eggs
Orthocarpus luteus Nutt. — Yellow owl-clover
Penstemon virens Pennell — Small-flowered penstemon
P. virgatus Gray ssp. *asa-grayi* Crosswhite — One-sided penstemon
Scrophularia lanceolata Pursh — Figwort
Verbascum thapsus L. — Great mullein

SOLANACEAE (Potato family)

- Solanum americanum* Mill. — Nightshade
Solanum triflorum Nutt. — Cut-leaved nightshade

UMBELLIFERAE (APIACEAE) (Parsley family)

- Aletes anisatus* (Gray) Theobald & Tseng
Angelica ampla Nels. — Giant angelica
Harbouria trachypleura (Gray) C. & R. — Whiskbroom parsley
Heracleum lanatum Michx. — Cow parsnip
Pseudocymopterus montanus (Gray) C. & R. — Yellow mountain parsley

VALERIANACEAE (Valerian family)

- Valeriana occidentalis* Heller — Valerian
V. edulis Nutt. ex T. & G. — Valerian

VERBENACEAE (Vervain family)

- Verbena bracteata* Lag. & Rodr.

VIOLACEAE (Violet family)

- Viola adunca* Smith — Mountain blue violet
V. biflora L. — Twin-flower violet
V. rugulosa Greene — Large white violet

Subdivision: Angiospermae — Class: monocotyledoneae

CYPERACEAE (Sedge family)

- Cores heliphila* Mack. — Sun sedge

GRAMINEAE (POACEAE) (Grass family)

- Agropyron* sp. — Wheat grass
Boutelova gracilis (H.B.K.) Lag. — Blue grama
Bromus spp. — Brome grass
Calamagrostis sp. — Reed grass
Oryzopsis pungens (Torr.) Hitch. — Rice grass
Phleum pratense L. — Timothy
Poa sp. — Bluegrass
Sitanion sp. — Squirrel-tail
Stipa spp.

IRIDACEAE (Iris family)

- Iris missouriensis* Nutt. — Wild iris
Sisyrinchium montanum Greene — Blue-eyed grass

LILIACEAE (Lily family)

- Allium cernuum* Roth — Wild onion
Calochortus gunnisonii Wats. — Mariposa lily
Smilacina stellata (L.) Desf. — Few-flowered false Solomon's seal
Zygadenus elegans Pursh — Death camas

ORCHIDACEAE (Orchid family)

- Corallorhiza maculata* Raf. — Spotted coral-root
Habenaria hyperborea (L.) R. Br. — Northern bog orchid

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Year One in the Perennial Garden

Andrew Pierce

Now that our perennial borders have passed through their first flowering season it is possible to start evaluating their worth. Even with such a young planting much interest was created and those here at the Gardens were pleasantly surprised and gratified as to how well the plants did in their first season. In my previous article (*Green Thumb*, Vol. 35 No. 4 Winter 1978) considerable outline of the range of perennials was given and a certain number of suggestions as to what you could use in your garden. After our first flowering season much of this still holds true.

During the winter, the borders were under protective coats of cut up branches of old Christmas trees, the idea being to prevent the rapid variations of temperature effecting the plants as much as would be normal out in the open. It acts as a temporary mulch and it will of course be removed in the spring prior to the earliest flowering bulbs. Due to planting problems few bulbs were planted in the fall of 1978 and it was only the tulip varieties Golden Appledorn, Smiling Queen, Cassini, Keizerskroon, and Beauty of Appledorn that were established. During the fall of 1979 the following were

planted so that a succession of the very earliest of flowers could be obtained:

55

Narcissus 'Professor Einstein', 'King Alfred', 'Fortune', 'Explorer', and the multiheaded *N. triandus* 'Thalia';

Hyacinths 'Delft Blue' and the yellow 'City of Haarlem';

Crocus 'Peter Pan' and the additional varieties of tulips — 'West Point', 'Burgundy', 'Maureen', and 'First Lady'.

These were obtained from the Netherlands Bulb Institute, Rocky Mountain Seed Co., and Vandenberg Bulb Co.

Also planted in the early fall of 1979 was a group of the very spectacular *Eremurus* Shelford Hybrids (*E. bungei* X *E. olgae*) from Vandenburg. These are also known as fox tail lilies and are somewhat touchy to grow in this area. They were planted 6 inches deep on a domed 3 inch layer of sand as they require more than the average drainage. It is essential not to break their thick swollen roots and also wise to leave the plants alone for two or three years so that they can establish properly. Two other bulbous types of plants, namely *Allium* and *Fritillaria*, were also

planted. The former are flowering onions and the latter include the very showy Crown Imperial or *Fritillaria imperialis lutea* L. and the somewhat smaller *F. persica* L. with violet/blue flowers instead of the yellow/red Imperials.

The Showiest?

56 It is of course difficult to pin-point the best out of such a wealth of plants and personal favoritism may have its influence as well.

Amongst the low ground covering plants several blue or near blue flowers appeared and the interesting but lowly member of the Campanula family *Adenophora nikoensis* Franch. & Sav. was delightful with its 10 inch high spikes of blue bells. The *Erigerons* or fleabanes are well known in our area and it was good to see how well and long they lasted here under cultivation. Another, perhaps more purple than blue, *Phlox divaricata* L. was floriferous over a longer period than the relatively well known dwarf *P. subulata* L. People may

be more familiar with these as rock garden plants but the value of perennial borders is that the plant range that can be grown is from the lowest to the tallest items such as *Macleaya cordata* R. Br. with its very interesting brown/green foliage. Another small and extremely worthwhile blue flower was *Polemonium foliosissimum* cv. 'Blue Pearl'. This was planted in the Denver Botanical Gardens House garden and I particularly liked the very delicate scent which it gave off, unlike our native Jacob's ladder which has an odor only when crushed and that a bad one.

No perennial border would be as noticeable without its accent on white and with some reservations I feel that we may need to add a little more in coming years. Whilst some people may consider it evasive and almost a weed, one of the most prolonged flower displays was put on by *Achillea ptarmica* cv. 'The Pearl' with its multitude of white clusters. These are quite unlike the typical umbels of the



Rudbeckia sp.

other *Achillea* e.g. *A. millefolium* L. The whites of the Shasta daisies *Chrysanthemum maximum* Ramond are always spectacular and now we have half a dozen to choose from. Two other white flowers, perhaps not so easily obtainable, are *Liatris scariosa* cv. 'White Spire' and *Echinacea purpurea* cv. 'White Lustre'. These are cultivars of well known border plants and certainly useful towards the back of the border.

Old Favorites

Why do the old favorites always appear? Be it their color or size of blossom I would suggest that we continue to see them for the simple fact that they are easy doers.

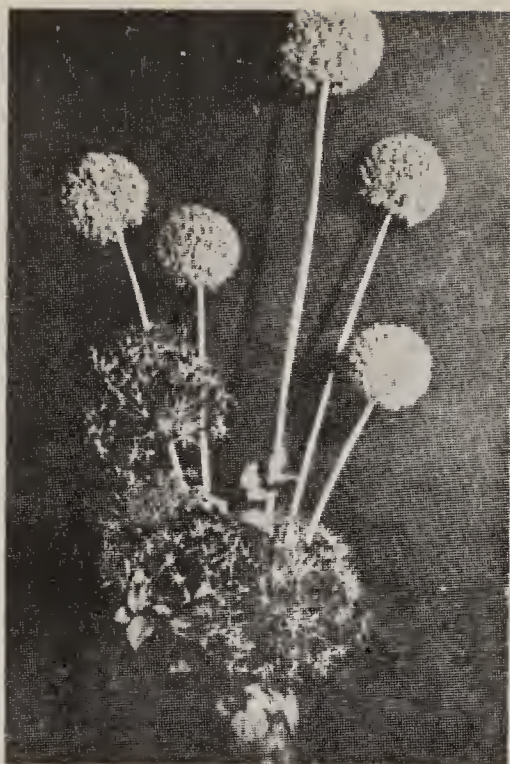
Notable are the phlox, poppy, aster, and delphinium. What a colorful display they create, and no border, if large enough, should be without them. They all have a multitude of colors from the early poppy right down to the aster.

Two of the latter not so well known are worth watching for. *Aster* cv. 'Frikartii' (*A. amelleus* X *A. thomsonii*) produced masses of sky blue flowers on 3 foot high stems in Sept./Oct. and was one of the showiest in the border at that time. Somewhat earlier *A. ericoides* cv. 'Golden Sunshine', an unusual color in this group, was noticeable at the back. Both of these plants are considered somewhat temperamental in the Denver region and it would be great if they survive with the minimum of protection mentioned earlier. A variety of the common aster or Michaelmas daisy to watch for is Sailor Boy, a vivid blue/purple flowering plant 3 feet high.



Daisy

Salvias have always been used in the border, principally the *S. superba* Stapf. types, but our most interesting one was *S. pitcheri* Lam. The flowers were almost topaz blue and on their 4 foot high stems quite magnificent. But there is a drawback as the plant flowers so late, often into October, that it is likely to be damaged by frost and even snow. This is even after the flush of autumn color produced by the masses of composites of which *Helenium autumnale* L. and its varieties stand out. Bruno with its almost brown petals was slightly later blossoming than the lemon yellow Riverton Beauty. Perhaps the tallest plant in the border was the lovely giant cone flower or *Rudbeckia* cv. 'Autumn Sun'. It is evasive so watch out. Another group of related plants is *Gaillardia* and the dwarf Baby Cole along with the taller Burgundy made great splashes of color.



Allium sp.

Flowers All Summer

Whilst perhaps asking for flowers all summer is too much, one plant can be considered to do just that. *Geum X borisii* has almost orange/scarlet flowers on 15 inch stems above very attractive fresh green broad-leaved foliage and you can always find a few flowers. Not far behind was *Malva alcea fastigata* L. which though starting later still had flowers when Old Man Winter came around. Very early *Linum perenne* L., the flax, flowered over a very extended period. It was interesting to see that one of our four plants was white. Blue is the dominant color as is shown in our native displays of *L. lewisii* Pursh in the foothills.

Another plant that produced color all the time, though not very floriferous, was the variegated *Iris pallida* Lam. whose yellow and green leaves show off the pale blue flowers. Of course the grey foliage plants such as *Cerastium*, *Artemisia*, *Veronica*, and *Fescue* give color contrast all of the season.

A few other plants that caught the

eye were *Lobelia sessilifolia* Lamb. with its rich blue flowers on 18 inch high stalks. *Oenothera missouriensis* Sims, much misnamed as the evening primrose, produced large 4 inch diameter yellow flowers in the daytime. As a matter of fact it is not even in the primrose family but in its own, Onagraceae. The hardy *Verbena bipinnatifida* Nutt. produced masses of magenta/red flowers on very spreading stalks. This was not in the best position in the border as we had some bad color clashes in this area. Another different plant was the yellow *Scabiosa pyreniaca* All.

One of my favorites, partly because of its orange *Iris*-like flowers but more for its large inflated seed pods which split open revealing their black seeds, was *Belamcanda chinensis* DC. or blackberry lily.

All in all we have come a long way in creating a perennial border worthy of exposure to the public and in the future no doubt more of this relatively low type of maintenance along with a prolonged flower period will appear. A few annuals will continue to be used for accent and splashes of color, principally where the bulbs had flowered earlier.



Lilium sp.

Plants Need Feeding

H. E. Owen

Fertilizer is the "vitamin" of the plant world. It is not a plant food; plants make their own food by the process of photosynthesis.

Fertilizer is the source of some of the elements needed by the plant to make new protoplasm (living material) and maintain old protoplasm. Just as we have one-a-day vitamin capsules, which supposedly furnish all the necessary minerals and vitamins we need each day, fertilizer does much the same for a plant.

A plant, unlike a human, can make its own vitamins, amino acids, etc. We cannot make a vitamin, we have to ingest them already made in our meats and vegetables. The plant on the other hand absorbs such things as nitrate, ammonium, phosphate, borate, molybdate, and approximately twelve other elements from the soil solution. These elements can then be used by the plant to make its own vitamins and amino acids from scratch so to speak. This is a very unique situation and is one of several reasons that we and all other animals are completely dependent for our very existence on plants. You see, the vitamins and amino acids made by the

plant are exactly the same as are needed and used by humans. As a matter of fact, we use them for the same things that a plant uses them for. 59

Perhaps a short discussion of how vitamins are used in protoplasm would be in order. All biochemical reactions are governed by molecules called enzymes. Enzymes are basically helper chemicals which speed up reactions in protoplasm. For example, the enzyme named cellulase speeds up the reaction which produces cellulose and eventually a plant's cell wall. Anyhow, vitamins are part of enzymes, therefore, for protoplasm to function, vitamins are needed to make enzymes to control protoplasm's biochemistry. Since all protoplasm is constantly being broken down and rebuilt, vitamins must be either rebuilt (plants) or replenished (animals) each day. Just as we have vitamin deficiency diseases (beri-beri, rickets, scurvy) in humans, we have mineral deficiency diseases in plants, which are actually vitamin deficiency diseases. The plant lacks the proper minerals to make the necessary vitamins needed to make such things as chlorophyll and as a result, the plant becomes chlorotic and ill. As you can see, a fertilizer is not a plant food, but a source of elements needed by the plant to make such things as enzymes.

All elements are not needed by the plant in the same quantities. Nitrogen, phosphorus, and potassium are needed in large amounts, and are referred to as the major or macro elements. These are the basic ingredients of a complete fertilizer. Calcium, magnesium, and sulfur which are needed in much smaller quantities are called secondary elements. Zinc, iron, manganese, copper, boron, molybdenum, and others are required by the plant in very minute amounts, only a few parts per million (ppm) are needed. These elements are referred to as trace or micro elements. Neither secondary nor trace elements are found in most fertilizers — one usually has to buy a special fertilizer to be sure to have these elements. However, they are just as important as the major elements of nitrogen, phosphorus, and potassium.

A fertilizer which contains nitrogen, phosphorus, and potassium is referred to as a “complete” fertilizer. On a bag of such a complete fertilizer will be three numbers. These numbers refer to the relative amounts of nitrogen, phosphorus, and potassium in that particular fertilizer. The number sequence is always the same — the first

number refers to nitrogen, the second number refers to phosphorus, and the third number refers to potassium.

Nitrogen is expressed as the actual percentage of nitrogen in the fertilizer. However, contrary to popular belief, the phosphorus and potassium numbers are not the actual percentage of these elements in the fertilizer. For example, a so-called 10-20-5 fertilizer actually contains 10% nitrogen in some form; 8.6% phosphorus, and 4.2% potassium. This manner of expressing the relative amounts of NPK in fertilizers is a matter of federal law, apparently lobbied through Congress by fertilizer companies.

The following table gives you some idea as to the uses of the various elements by a plant. I have included carbon, hydrogen, and oxygen just to be complete. My intention in writing this article and preparing this table is to perhaps increase your understanding of WHY fertilizers are used. It is my conviction that the WHYS are the *pièce-de-résistance* that is needed to achieve maximum enjoyment and understanding of successful gardening whether indoors or outdoors.

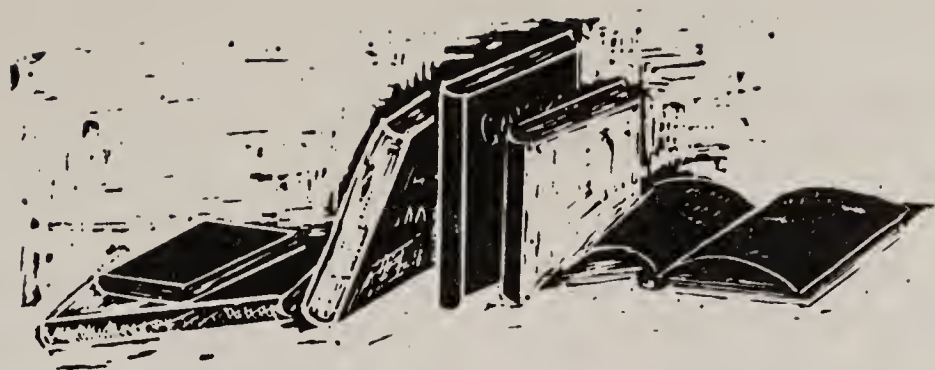
ESSENTIAL PLANT ELEMENTS

ELEMENT	SOURCES	USES IN A PLANT
Carbon (C)	Carbon dioxide of air	Process of photosynthesis; stimulates growth by producing new organic compounds
Hydrogen (H)	Water from soil	Process of photosynthesis; stimulates growth by producing new organic compounds.

Oxygen (O)	Carbon dioxide & oxygen of air	Respiration (burning of sugar for energy); part of organic compounds; stimulates growth by producing new organic compounds and by producing energy for all plant processes	
Nitrogen (N)	Nitrate & ammonia from soil	Raw material for proteins, chlorophyll, and genetic material (DNA and RNA) and for energy carrying compounds (ATP & ADP); stimulates fruit, seed, and root production and early season growth; increases winter hardiness	
Potassium (K)	Potassium (K ⁺) soil ions	Necessary for sugar movement from leaves to developing fruits and seeds and for starch formation. It helps water movement; stimulates flower, fruit, seed and root production and increases disease resistance; increases red pigment in fruits, flowers, and leaves; increases blossom size	61
Calcium (Ca)	Calcium (Ca ⁺⁺) ions in soil	Raw material for material holding cell walls together and raises soil pH; aids genetic stability; promotes root hair formation and early growth; makes a sturdier, stockier plant	
Magnesium (Mg)	Magnesium (Mg ⁺⁺)	Raw material for chlorophyll formation; activates enzymes (causes them to function) particularly those involved with nitrogen reactions; it increases oil production; helps regulate uptake of other elements; makes a greener, healthier plant	
Sulfur (S)	Sulfate (SO ₄ ⁻) ions in soils	Raw materials for certain amino acids and thus for proteins; necessary for legume nodule formation; raw material for certain oil compounds that give specific odors to some plants such as onions, garlic, mustard, etc.; it is also a raw material for certain protein forming enzymes and it increases oil production in flax and soybeans	
Zinc (Zn)	Zinc (Zn ⁺⁺)	Raw material for several enzymes including those that form growth controlling substances; stimulates stem growth and flower bud formation	
Iron (Fe)	Ferrous (Fe ⁺⁺) or Ferric	Raw material for several enzymes including those that form chlorophyll and those that help oxidize (burn) sugar	

	(Fe ⁺⁺⁺) ions in soil	for energy; also necessary for legume nitrogen fixation; makes a greener, healthier plant
Manganese (Mn)	Manganese ions (Mn ⁺⁺) in soil	Raw material for chlorophyll formation and sugar burning enzymes and activates several other enzymes (causes them to function); it helps in the process of photosynthesis
Copper (Cu)	Copper (Cu ⁺⁺) ions in soil	It is an enzyme activator (causes them to function), particularly for certain protein forming enzymes and Vitamin A forming enzymes; it stimulates stem development and pigment formation
Boron (B)	Borate ions in soil	It helps move sugars from cell to cell; controls starch formation, stimulates cell division, flower formation, and pollination
Molybdenum (Mo)	Molybdate (MoO ₄ ⁻) ions in soil	Needed for nitrogen fixation and nitrogen use in the plant, specifically it is needed to make amino acids; it stimulates plant growth and vigor very much like nitrogen
Chlorine (Cl)	Chlorine (Cl ⁻) ion	Needed for photosynthesis; stimulates root growth and aids water movement in plants
Cobalt (Co)	Cobalt (Co ⁺⁺) ion	Needed by <i>Rhizobium</i> for nitrogen fixation; helps form Vitamin B12; improves growth, water movement, and photosynthesis; improves boll production in cotton; activates certain enzymes; very necessary for sheep and cows
Sodium (Na)	Sodium (Na ⁺) ion in soil	Necessary for proper carbohydrate production and use; increases resistance to drought; increases sugar content in some crops (sugar beets)
Silicon (Si)	Silicate (SiO ₃) ion in soil	Increases the number of seeds (particularly in rice and other grains); increases sugar cane growth

A most important aspect of fertility is balance between the elements. This is often overlooked. For instance sodium can substitute for potassium up to a point. Phosphorus is necessary for uptake of all elements. The balance between iron, molybdenum, manganese and copper is very important.



Looks at Books

Nelson, Ruth Ashton. 1979.
Handbook of Rocky Mountain Plants, 3rd. edition. Estes Park, Colorado: Skyland Publishers.

Many wildflower lovers of this area who are confused by the technical maze of the botanical manuals or are frustrated by the over-simplified popular handbooks have found the *Handbook of Rocky Mountain Plants* by Ruth Ashton Nelson an answer to their desire to identify plants.

They will be happy to learn that a third edition is now on the market. This is not just a reprint; it is a revision with several improvements in the simple keys, better paper for the color plates, and added descriptions for several species, especially in the Composites.

This edition has all the good features of the previous ones. It describes more than 700 plant species that may be met with in the Rockies from northern New Mexico to the Canadian border. The opening pages with their interesting descriptions of the ecology of the plant zones are retained. Mrs. Nelson is not only a trained botanist with a wide

knowledge of the flora of the area, she is also a devoted and gifted teacher who has a gift for noticing and mentioning facets of a plant that are not mentioned in the botanical descriptions so that the mysteries of plant identification are cleared for the earnest amateur. Every page of the *Handbook* reflects her love of nature in general and of wildflowers in particular.

Those who have used and enjoyed either of the previous editions will not only recommend this new edition to those who wish to learn about the Rocky Mountain wildflowers but also will profit by adding it to their own collection of wildflower books. Mrs. Nelson has also written *Plants of Rocky Mountain National Park* and *Plants of Zion National Park*.

Berta Anderson



Phlox

Larry Latta Promoted

Following a period of vacancy in the Conservatory we are pleased to announce the upgrading of one of our staff to the rank of Botanist-Horticulturist.

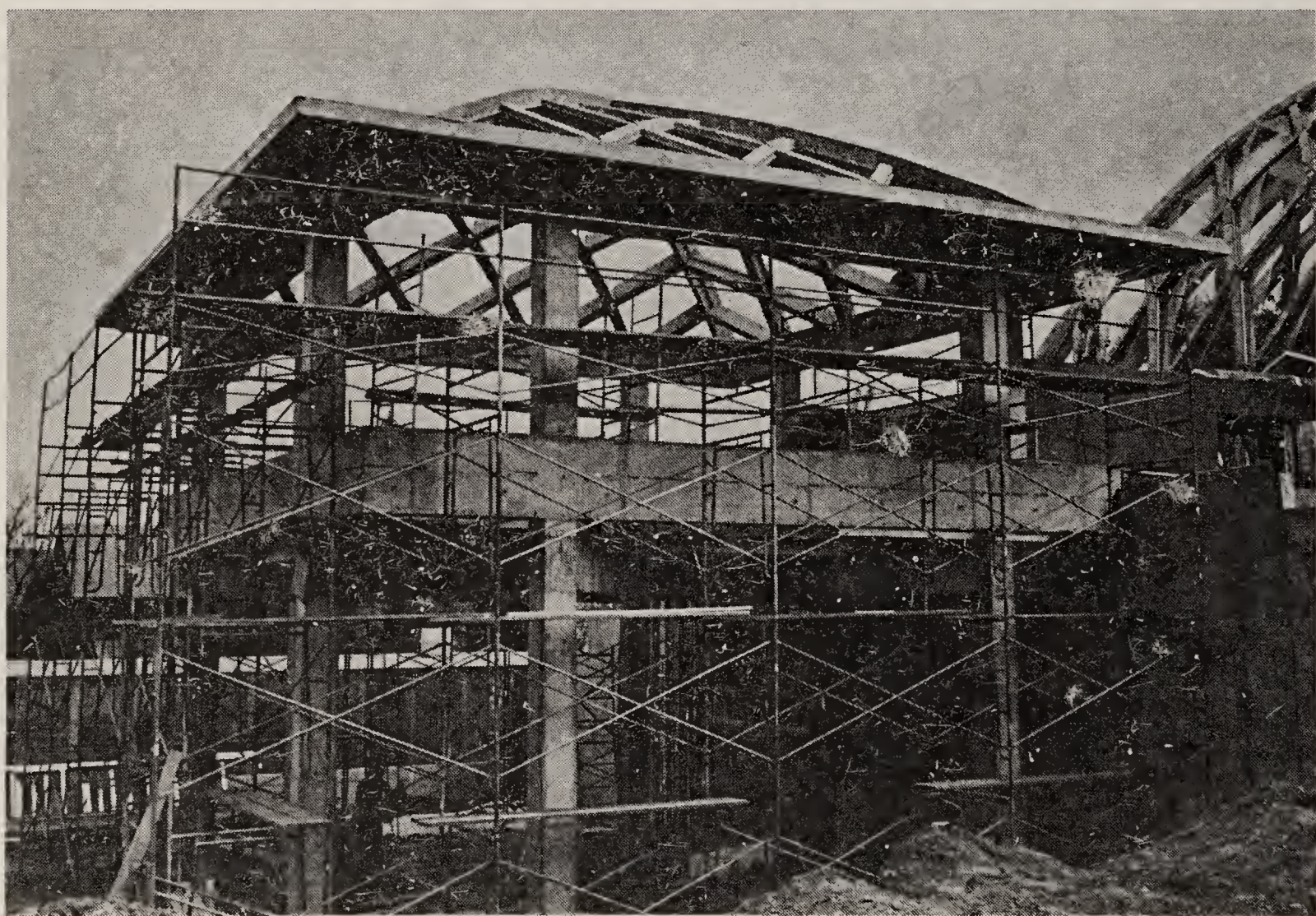
Mr. Larry D. Latta who has been with the Gardens for 6 years, having started as seasonal laborer, was promoted to the position as of 1st February 1980.

64 Prior to then he had been working in the greenhouses, and he will continue to maintain the orchid collection in that area. These of course will be transferred into the new Orchid/Bromeliad extension currently being constructed at the west end of the Conservatory.

Mr. Latta, a native Coloradan from Delta on the western slope,

graduated from Delta High School in 1959 and later took further education at Colorado State College in Greeley, University of Colorado in Boulder, and Community College in Denver. Before coming to the Gardens he was employed at 3rd Avenue Florists as a grower.

He is already involved in classes for guides and other subjects at the Gardens and he serves on the Library committee. Here he finds time to review books and tries to catch up on his reading of horticultural material. Other pursuits include photography, travel, and classical music. In the past he has helped collect plants for Denver Botanic Gardens in Mexico.



Orchid — Bromeliad Display House

Progress continues on the new Orchid/Bromeliad house at the west end of the Conservatory. Amongst the major contributors have been the Ed Honnen family. With current progress completion should take place during the summer.

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Autumn Harvest

The Green Thumb
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Denver Botanic Gardens, Inc. maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Continue Growing With Orchids

Larry D. Latta

66

On a hot summer morning, does corn actually grow so fast you can hear it? I don't know; that's never happened within my hearing. But one thing I do know: the huge waxy buds of *Stanhopea peruviana* Rolfe. open so fast you can see them. You can actually watch the movement of the pale, wing-like sepals as they sweep upward one hundred eighty degrees through a graceful 11 inch arc, as the petals jerk and curl, and each amber globe of a bud is swiftly transformed into an incredibly sculpted pendant blossom which resembles nothing so much as an attacking eagle. It's a mildly hair-raising process which takes less than five minutes. I watched it in my living room on a recent hot summer morning.

With hope that I can encourage others to grow orchids and enjoy such moments, I offer the following observations on their cultivation in the home.

Now, even as orchids go, stanhopeas are bizarre; but hundreds of other kinds can provide enough interest or beauty

or downright dependability for you to include them in your home with other plants. The three keys to the successful exploration of the world of orchid growing are: 1) the selection of the right kind for the particular spot you have in mind; 2) modification of this location, if necessary; and 3) your overall attitude toward plants in your home.

To illustrate this last point, may I mention a few acquaintances of mine who typify several orientations, conscious or not, toward growing houseplants? One (she's not a member of the Gardens) is a cautious conservative. She grows an extensive philodendron in her kitchen. She had a struggling streptocarpus but tossed it out. As she explained, "Why bother? For the dining room, I'll just take a couple more slips off my Philly." Another is definitely romantic; she remembers those balmy nights in Hawaii, and recently dreamed, "A hibiscus by the fireside would be such a nice reminder of Waikiki." Third, consider my delightful decorator friend who wants to balance the grandfather clock at the entrance with something along the stairs, and who was heard to exclaim "We have to

Larry Latta is a Botanist-Horticulturist with the Denver Botanic Gardens. He has written other articles for *The Green Thumb*.

find something tall and narrow — something that makes a statement! With variegated leaves to match the drapes. A Warneckei? Marvy!" And, finally, is an aficionado who's a specialist, an amateur botanist who doesn't have plants; he calls it a collection. He recently mentioned to me proudly that "the little rarey there from Raratonga (It's in the genus *Adnausea*.) is the only one in cultivation this side of the Atlantic."

I hope, besides these people — all very real, if hypothetical — there's you, who won't settle for a canopy of philodendrons in every room; who realizes the living room may not support green life, but another room might; who appreciates plants for their infinitely varied expressions of living form independent of mere utility; and who want interesting plants in your home and want to know their names on occasion but want them to complement rather than overpower your intellectual existence. If so, let's turn to look at the possibility of your growing orchids.

Orchid Habitats Vary

First, be heartened to know that there are tens of thousands of kinds; and they or their ancestors come from all around the world, from all climates except polar and sub-marine. So, although no one kind will adapt to all habitats, we can surely choose from this diversity one or more for each habitat.

Most orchids in which we are horticulturally interested come from what are called the tropics, and, although this is a vast and complex area difficult to

generalize, a major obstacle to accommodating orchids is naturally diminished; we, too, live within our shelters in different tropical environments. Our temperatures range from 55° - 60° at night up to 75° - 90° (Fahrenheit) during the days, a range quite acceptable to many cultivated orchids. In our High Plains/Rocky Mountain area the major non-tropical factor with which we must contend is the lack of humidity in our air, especially in the winter. But there exist in several regions of the world dry climates where many beautiful orchids prosper. 67

Since sunlight is the most varying growth requirement in your home, let's investigate the several areas where you may wish to grow orchids.

Let's begin with the hypothetical worst case, perhaps a bookcase across from the north window in the den. Here you already grow more common houseplants; a spathiphyllum (sail flower) is thriving and below it on the floor flowers an aglaonema (Chinese evergreen). A most unusual orchid to grow as their companion would be *Haemaria discolor* (Ker-Gawl.) Ldl. or one of the other jewel orchids. Terrestrial inhabitants of the deep forest floor, these have broad leaves of dark red or blackish green brilliantly veined with pink, gold, or silver, truly belying the reputation that orchids are unsightly except when in bloom. Since these species come from the humid tropics, enclose them in a glass terrarium, using a very loose soil and watering carefully.

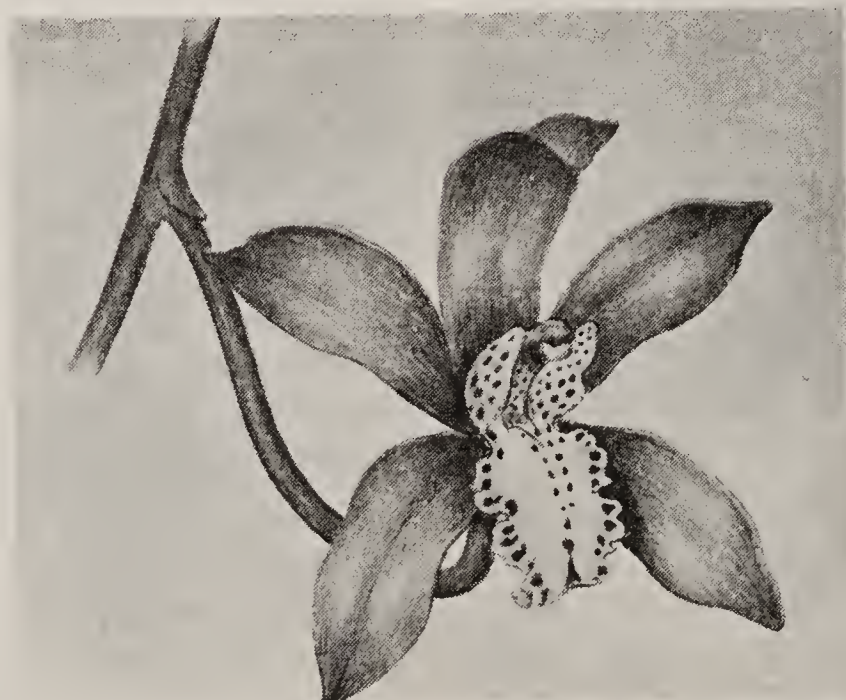
68 Looking for a room with more light, is there a Colorado bathroom with an outside window which doesn't sport, at least, a sciandapsis (devil's ivy), hederá (true ivy) or a hanging basket of plectranthus (Swedish ivy)? Or even a fern or two? In this place the humidity is probably high enough for just about any plant, unless the temperature remains too high during winter nights, drying out the air when water usage is low. But a bathroom window is usually small or frosted, or both, so the limitations of fairly low light still affect your choices. Since space is at a premium here, recommended orchids to grow among the "ivies" are a grassy-leaved *Maxillaria tenuifolia* Ldl. whose spotted flowers smell incredibly of coconut cream pie, *Promeneá xanthina* X. with 2-inch yellow flowers on a plant scarcely as large, a coral red *Rodriguezia secunda* HBK or its fragrant sibling *R. venusta* (Ldl.) Rchb. f. Slightly larger plants, though still very manageable by orchid standards, are the leathery leaved *Phalaenopsis* hybrids with their arching sprays of large pink or white (and now, thanks to modern breeding trends, yellow,

green, striped, spotted, and barred) moth-like flowers, among the most beautiful of all flowers.

Orchids for the Bathroom

For the plant grower who has a sense of humor to match his adventuresome spirit of acquisition, for most of these plants are scarce on the market, I'd wholeheartedly recommend a bathroom outfitted with a myriad of sparkling narrow glass shelves against mirrored walls for a gathering of the true miniatures of the orchid world such as *Pleurothallis*, *Restrepia*, *Lepanthes*, *Sigmatostylis* and others with long names of inverse proportion to the size of their jewel-like flowers. They often call for a magnifying glass for their true appreciation but since the plants, too, are tiny, the average bathroom, if this one could still be called that, might house two hundred or more of these fascinating orchids.

The greasiest parlor palm I ever saw was a very sick one brought to me for diagnosis by a Denver lady some years ago. She'd had it in her kitchen for several seasons. Now, her kitchen, I'm



Cymbidium sp.

sure, was spotless because she had, as she said, "help". She enjoyed a high degree of success with her other house plants, but both she and her maid had failed to notice the gradual accumulation of grime on the palm, slowly and inexorably suffocating it, clogging its pores, and shading out the light with layers of dingy grit. Since she was not one to change her habits quickly, I suggested she not have plants in her kitchen.

However, if you (or your help) occasionally refresh your kitchen plants with a sudsy bath, several orchids would happily accompany them in their semi-annual dip. Let's assume growth conditions similar to the bathroom but with larger windows, perhaps a view, and therefore more sunlight and more space. In indirect or filtered light, the graceful blooms of *Phalaenopsis*, again, can successively adorn their plant for half a year beginning in early spring. You should also succeed with any of the *Paphiopedilums* ("Cyps" in outmoded florists' jargon, and also called the slipper orchids or ladies' slippers). In fact, these extremely long-lasting terrestrials from Asia are, in general, treated like regular houseplants and should be grown by every plant enthusiast.

For Sunny Spots

Does your window face southeast, south or southwest, with sunlight unobstructed by trees or overhangs? Frankly, once you attain this light level in any room your choice of plants is limited only by space and by the level of moisture in the air. It's unfortunate, but the more sunlight there is, the more heat; and the more heat there is, the lower the relative humidity.

Given direct sunlight and expanses of glass, consider using hanging redwood baskets of the aforementioned stanhopeas around the periphery of the view where they'll receive partial light. Several species are available and all exude intense fragrances. Grow clove-scented *Lycaste aromatica* (Brah.) Ldl. with the same striking, palm-like foliage, or another pretty species of this Western Hemisphere genus. Be warned, though: once a year lycastes lose their leaves; merely reduce watering until new growth and flowering begin. In their dormant state they save space and sunlight. As space-savers, a group within the genus *Oncidium* known as the "equitants" has no equal, especially considering their number of flowers and size of their inflorescence. Three- to 6 inch natives of the Caribbean, they exhibit on 12" to 24" spikes numerous dancing blossoms in combinations of yellow, brown, red, or pink. Cultivate them most successfully not in pots but attached to cork bark or cedar plaques. As hanging plants they display themselves attractively.

Perhaps on the floor near the glass place a large tub of *Sobralia xantholeuca* X or *S. macrantha* Ldl. Potted in loose, but terrestrial medium, given full sun, and watered like a common schefflera, these tall orchids reward you with ephemeral, large, crinkly summertime bloom of delicate yellow or rose, the equal of any corsage flower, though short lived. When not in bloom, sobralias sport foliage and habit superior to your chamaedorea palm ("neantha bella"). *Phaius tankervilliae* (Ait.) Bl., with brown and silver flowers on a stately spike, needs less sun but responds to similar treatment.

Though deciduous from October through January, signalling a need for less water, its summer leaves are magnificent. It, too, needs lots of space and is, perhaps, best suited for a formal solarium or plant-room.

70 A plant-room or sunlit pool room? Well, now you've reached the pinnacle of in-home growing, second only to a technical greenhouse. Your personal preferences, alone, dictate the limitations of your enjoyment of orchids here. Its depth allows for sun lovers and shade lovers; its breadth for large floor plants or banks of hanging baskets; and its ability to hold a great number of different kinds of plants directly confronts the humidity problem: each plant, by its transpiring, releases water into the air for the comfort of its neighbors.

Purposely, I've not previously included the major corsage genera *Cattleya*, *Vanda*, and *Cymbidium*. Hybrids of these have come to epitomize orchid for most of us. Indeed, they predominate among the most beautiful and long lasting flowers of any family. However, as houseplants they have shortcomings. *Cattleyas* and *Vandas* are coarse and hardly attractive when not in bloom, which is most of the year. And *Cymbidiums* notoriously refuse to bloom unless exposed to long, cool nights outdoors at a critical stage of each year's maturation. If you accept the challenge of these limitations, by all means try them.

Orchid Care Outlined

Now that we've seen the various places in the house where orchids

belong, how do you care for them? Hundreds of books have been written on this subject; I'll limit my observations to a few, brief remarks. Please forgive me if they are more philosophic than pedantic, but may they still offer guidance.

Humidity: 30% is bare minimum for most. If you won't augment the humidity in your living spaces during the winter in Colorado, at least lower your room temperatures at night. Fifty-five degrees (F.), the lower limit of many thermostats, is ideal and all your houseplants will thank you. However, your orchids, books, furniture, and eyes will all welcome additional airborne moisture.

Soils: Most cultivated orchids are strict epiphytes, that is, they grow in trees with their roots high above the earth. They demand a very fast-draining medium around their roots or none at all. In our area, various sizes and mixes of fir bark are the most suitable for filling around the roots of those plants we grow in pots.

Watering: Because water runs right through such a coarse mix very rapidly, getting the contents of a pot wet is difficult once it dries excessively. This necessitates copious water and a system to handle splashes. I admit, orchid growing can be messy, an important consideration, especially for renters.

Air circulation: Try to envision the fresh, breezy atmosphere that follows a summer rain. The air is bouyant; you can smell it. Now, strive to duplicate that. Especially in a bay window or in one of the newly popular green-



Vanda sp.

house windows, keep the air moving: both sun heat and winter cold can quickly endanger your plants in such small enclosures.

Pests and diseases: Fondling hands and smothering concern easily top the list. Wait until they approach before you worry about the lesser evils.

Potting and re-potting: When you find it necessary, try to learn these tasks under the tutelage of a long-time grower. Make it a hands-on education. If that is impossible, Rebecca Northen, a long time expert from our region, gives excellent, illustrated direction in her major book, the first discussed below.

As you can imagine, many others enjoy orchids at home. The Denver society of orchidologists numbers something over two hundred growers, almost all of them friendly if given a chance. They encourage newcomers to attend a meeting or two to become acquainted. Take advantage of this invitation. Further information on the society and its current officers is available in Helen Fowler Library at our Gardens.

Also at our Library resides one of the finest collections of orchid books imaginable. Some of them I recommend below for your assistance and pleasure.



Cattleya sp.

Obviously, I've not set out here to cover all aspects of growing orchids, or even to exhaust those few facets of this captivating family with which I'm familiar. Rather, my intention has been to share some of my enthusiasm and to say of the feasibility of growing orchids: your home can entertain the possibility if you will.

Selections for further reading:

Rebecca Tyson Northen's *Home Orchid Growing* (Van Nostrand Rheinhold) has nurtured the skills and enjoyment of a generation of devout orchid lovers. It will be invaluable also to you, who may wish only to consult it briefly. More recently, she's written *Miniature Orchids* (Van Nostrand Rheinhold) a publishing

victory which will certainly stand in authority beside her older effort. Its excellent illustrations and encyclopedic range make it a godsend for growers interested in the ultimate space-savers.

Another new book, *Orchids for Everyone* by Brian Williams, Peter Dumbleton, Ray Bilton, *et. al.*, (Crown Publishers) is the best general guide to come from Britain in some time because it finally reconciles this land of long-time orchid growers with modern horticultural practices. You may profitably consult it.

Finally, read Jack Kramer's old book *Orchids at Your Windows* (Hawthorn Books). With good drawings and plain, honest text, it remains the best work of this now classic gardening writer.

Desert Wild-Flower Trip

Ruth Ashton Nelson

Thirty enthusiastic plant lovers flew from Denver early on April 12th. The flight to Phoenix was comfortable and we were soon settled in a pleasant motel in Scottsdale in a sub-tropical setting of palms, luxuriant shrubs, and colorful bougainvillea. Dr. Moras Shubert, of Denver University, was our botanical escort and his knowledge of the desert environment added much to our pleasure, comfort, and information.

That afternoon our first visit was to the famous Heard Museum in Phoenix. This institution is dedicated to the comparative study of man and his works. It gave us a very good introduction to the culture of our American southwest. Fine exhibits of photographs and artifacts from the different periods and areas of the Pueblo Indian world were on display. We were shown how these people were able to adapt to their arid environment by learning to utilize the native resources.

From here we were taken to the interesting home and garden of Mrs. Carl Norgren, a well known

Denverite, who graciously opened her garden to us. It is a beautiful example of the intelligent and effective use of desert plants in modern landscape design.

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The following morning we left by bus for an all day trip to the Boyce Thompson Southwestern Arboretum, near Superior. Here Col. William Boyce Thompson, who had made a large fortune from copper mining, "as his contribution to mankind established and endowed the Arboretum for the study of arid land vegetation." We were able to see plantings of desert species from many arid type areas. There are African and Australian gardens as well as many plants from Baja California and our own Sonoran desert.

The Arboretum was established in 1927. It is now administered jointly by a Board representing the Arboretum, University of Arizona, and the Arizona State Park Board. It was probably the first institution to experiment with the native jojoba, *Simmondsia chinensis* (Link) CK. The fruits of this shrub provide a wax very similar to sperm whale oil and valuable for many purposes.

After listening to an interesting lecture on the origin, development, and experimental work of the garden we watched many

Ruth Ashton Nelson is a well known Colorado botanist. She has written several books about wild flowers and has been a frequent contributor to *The Green Thumb*. (See Summer 1980 issue for review of the latest revision of *Handbook of Rocky Mountain Plants*.)

hummingbirds feeding from a bed of beautiful coral-red aloe blossoms. Then we followed the principal trail through the gardens.

74 Along the higher part we found the natural vegetation, creosote bush, jojoba, mesquite, foothill paloverde, also agaves and yuccas. In Queens Creek Canyon we saw the natural streamside growth, trees of Fremont cottonwood, Arizona sycamore, ash, walnut, and "desert willow" (not a true willow). Other plants seen at the Arboretum were: an Australian pine, and the leafless but green-stemmed thorn tree.

There are two greenhouses where plants too tender to withstand the coldest of the winter temperatures are grown. One, a cactus house, holds specimens of cacti from southern Mexico, Central and South America. The other contains succulents, other than cacti, from southern Mexico and around the world, especially Africa.

Our next visit was to the Kofa Mountain Game Refuge on the edge of the Mojave, a region set aside for the rare desert bighorn sheep. Our destination was the palm canyon, the only place outside of California where the *Washingtonia* palm is indigenous. This is a fan-leaf type palm, *Washingtonia filifera* H. Wendl., a relic of early geologic time. Hiking up a rough trail we came in sight of the palm grove and had a good view of the glistening green fronds in a narrow, almost perpendicular, rocky sided canyon opposite to us. Along the trail we found some flowers — the tiny goldpoppy, the interesting *Eucnide* with rough foliage and large pale yellow



Saguaro

blossoms. While resting we watched white-throated swifts circling over the canyon and heard the charming descending call of the canyon wren.

That night was spent at Yuma, then across the desert eastward. This desert is covered with an evergreen shrub, creosote bush. Its somewhat smelly leaves give a yellowish-green aspect to the landscape. Here it was in full bloom with many yellow flowers interspersed with the white fluffy fruits. The foothill paloverde was coming into bloom, bushy trees



Yucca blossom

appearing like great golden bouquets and ocotillo, long thorny stems tipped with showy red blossoms.

Organ Pipe Monument Visited

Next we visited Organ Pipe National Monument, one of the highlights of the trip. This reservation was established to preserve the best, and almost the only, indigenous growth of "pitahaya dulce", *Lemaireocereus thurberi* Britton and Rose, a clump cactus up to twenty feet tall with stout branches from its

base. The very sweet fruits are described by the term "dulce" in the Mexican name. Many other rare species of plants and animals occur in this region, especially the old man cactus or "Senita", *Lophocereus schottii* Britton and Rose, which has a similar growth habit to the Organ Pipe but is only about half as tall and is distinguished by having the spines on the upper part of the stems developed into long whitish hairs. This area is really a "luxurious" desert. There are also many showy annuals which after a rainy period give brilliant color to the slopes, particularly purple owls-clover and goldpoppies.

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At the little oasis of Quitobaquito there are springs and we found shade in which to eat our lunches. In these comparatively warm and somewhat saline springs lives one of the endangered species of desert pupfish. These tiny creatures, not over two inches long, have evolved over centuries from the larger forms inhabiting the ancient sea which at one time covered this area.

From here as we returned to our motel at Ajo we had a fine view of the great pit of the New Cornelia copper mine, the second largest in the country. This great hole is more than 900 feet deep and over a mile wide at the top. We could see the huge power-shovels scooping out the ore at the bottom, loading it on to cars which were pulled up the long spiral railway, from where it was dumped into the hoppers which fed it to the mill. Later the group was given hard hats and escorted through the mine by mine officials.

Tucson Area Full of Interest

On the way to Tucson we visited the Kitt Peak Observatory where we saw the greatest assembly of telescopes for celestial observation in the world. This location was chosen in 1958 after 150 other mountain sites had been investigated because it had the clearest air. The site is leased from the Papago Indians.

- 76 On Friday we first visited the western section of the Saguaro National Monument. Here is a very impressive stand of the giant cacti. They stand as erect as soldiers of a great army over the desert slopes of the Tucson Mountains. Here we were given interesting information on the life history of these exceptional plants and their environment by a knowledgeable and courteous ranger, Mike Niss. Also we each received a packet of seed. The fruit of the Saguaro has long been an important part of the food of the local Indians. The National Park Service allows them to harvest these fruits for their own use and in return they give the seeds to the Service. They are then passed on to

visitors. The seedlings will grow indoors at a rate of about 1 inch per year.

At the Arizona-Sonoran Desert Museum, another highlight, we had a summary of all that we had seen. Here we were able to observe many of the interesting animals of the desert. This museum has pioneered in arranging to display its exhibits in very natural settings, reconstructing their native habitats. We also found many of the native plants flourishing and blooming in this ideal situation. This was a fitting close to a very enjoyable and informative week of desert exploration.

As a finale many of us had dinner together at an attractive Mexican restaurant, complete with indigenous music.

As a serendipity, just before leaving, we had an informative visit to the Environmental Research Laboratory of the University of Arizona. Here very interesting and productive experiments are being carried on in the development of advanced technology for energy production in desert areas of the world.



Desert scene

80 Years Young — An Old Art Matures

Julia Andrews-Jones

Landscape Architecture seems to have an unclear image for the general public. The changes in the professional practices of landscape architecture and how we look at ourselves, and the changes in the scope of services offered have helped to “fog” our professional image.

The 80th Annual Meeting of the American Society of Landscape Architects (A.S.L.A.) will be in Denver November 22 -25, 1980. It is a good time to learn what this profession is about in 1980. If the 11 people at the original meeting in the offices of Parsons and Penticost in New York City on January 4, 1899 to discuss the future of landscape architecture could peek in on this meeting they would be astounded at the numbers, the scope, and the specialties in the profession today.

When Frederick Law Olmsted and Calvert Vaux won the competition for the design of New York's Central Park in 1858, they described their work by a new term, landscape architecture. In 1863, the New York Board of Park Commissioners accepted

their designation as landscape architects. This is believed to be the first time this term was used officially at any level of government in the United States. Since that time the teaching and recognition of landscape architecture as a profession world wide has been led by the United States.

The first 40 years of professional record of accomplishment consisted solely of two unequal parts — the distinguished large national practice of one man's office, Frederick Law Olmsted's, and an astonishingly small number of independent practices that mirrored the scope of the large one on a miniature scale. The work was centered on residential properties, large city parks, and institutional grounds.

Olmsted took apprentices into his office, the only landscape architectural training available in the nineteenth century. Of these, Charles Eliot, Henry Codman, and Warren Manning were to leave lasting professional records.

In the late 1890s a few more had joined the professional ranks. Codman, Vaux, and Eliot had died, H. W. S. Cleveland (the Minneapolis Park System) and F. F. L. Olmsted were in declining years. The 11 that met in 1899 to form the A.S.L.A. were Nathan F. Barrett, Beatrix Jones (Farrand) who is best known for Dunbarton

Julia Andrews-Jones, after returning from Africa, did not go back to formal practice, but she keeps busy with a mountain acreage and a growing family. She also does some professional work that comes her way informally.

Oaks, Daniel W. Langton, Charles N. Lowrie, Manning, John Charles Olmsted (nephew of the senior Olmsted), F. L. Olmstead, Jr. (son of the senior Olmsted), George F. Penticost, Jr., Samuel Parsons, Jr. (who started as an assistant on Central Park), Ossian C. Simonds (of Chicago), and Downing Vaux (son of Calvert Vaux).

78 Professional education in landscape architecture was established at university level immediately following the organization of A.S.L.A. These "juniors" branched out geographically and into more specialized areas of practice. The first works of landscape architecture were for the public, but gradually a noticeable amount of residential work came into the offices. The growing affluence of industrial America soon made large residential projects the important part of a practice. After the publicity given these estates and their designers, landscape architecture had to struggle against the image of serving only the wealthy.

Charles Platts introduced Italian garden concepts and their crisp spaces, a new trend after the flowing lines of meadows and woods and their feeling of a managed, natural landscape as in Central Park. The Italian gardens also influenced landscape architects to consider the integration of the design of the grounds with the plan and spatial use of the residence. The American Academy in Rome had been established by Congressional decree. In 1915 a Rome Prize in Landscape Architecture was founded so that every two years a new practitioner was given a chance to study in Italy.

After World War II landscape architecture was very innovative on the west coast. With the demand for casual indoor-outdoor living on smaller plots of ground an impact was made on residential landscape architectural design that revived interest in the design professional. No longer was a design team complete without a landscape architect. The profession had demonstrated in the gardens in California the necessity for a total approach to the design problem, therefore inviting collaboration from the beginning. They gave the United States the model for the "maintenance free" garden and brought back to the practice in the 1950s the residential client who had been missing since the Depression era.



Treatment of stairs

Profession Grew Slowly

In the first half of this century the profession grew slowly in numbers and slowly westward. Students at Harvard School of Landscape Architecture went on to head departments at the universities of Pennsylvania State, Illinois, Michigan, Michigan State, Georgia, Iowa State, and California at Berkeley. By 1955 there were 12 schools offering an accredited curriculum of four years for a B.S. and five years for a B.A. Most of these offered a master's program while at Harvard only a graduate level was offered. Charles Eliot II was for many years the professor. City planning was first taught in the School of Landscape Architecture at Harvard in 1909.

Denver Offices Opened

In Denver, after World War I there were very few offices. Irvin J. McCrary formed a partnership with Arthur Carhart and Mr. Cully with offices on the top floor of the Mining Exchange Building. During the Depression Carhart joined the Forest Service. He was very vocal in his later years for conservation and preservation of our wild lands. S. R. DeBoer came to Denver in 1910 and started employment as a laborer in the City of Denver Nursery. He advanced very rapidly because of his knowledge of plant materials, plant culture, and Mayor Speer's vast park expansion program. His first office was opened with M. Walter Pesman in the Tramway Building. In later years Pesman was landscape architect for the Denver Public Schools. His 6'5" stature and his galloping gait were a familiar sight on the slopes of Mt. Evans as he led his

classes on identifying and enjoying the native plants. Frances White (Novitt) and Edmund Wallace were in S. R. DeBoer's office before joining the city parks staff. Ed was chief landscape architect when the state proposed that I-70 be routed through the parks in the northwest quadrant of the city. He fought hard to keep that land in the park system and not violate the parks with high speed highways. When the City of Denver lost the fight he went to Montreal as landscape architect for the World's Fair. Robert O'Donnell left McCrary's employment to start his own firm with "Tex" Harmon, O'Donnell, and Henninger; now known as H.O.H., they became well known nationally for their subdivision designs. Sam Huddleston came from a National Park Service background where he had worked on the Blue Ridge Parkway design, to buy McCrary's office when he retired.

Through an acquaintance with McCrary, Julia Jane Silverstein's father learned of the profession and that it was a suitable field for a woman. The course of study sounded so much more suited to her talents than her studies at the University of Colorado that she left for the Lowthrope School of Landscape Architecture at Groton, Mass. On her return to Denver she worked for McCrary, Carhart, and Cully before starting her own office in the studio over her garage in 1938. In 1961 she took a partner, Julia Andrews, and changed her practice name to Jane Silverstein Ries. That partnership was dissolved in 1963 when Julia Andrews was married and left Denver to live in West Africa.

Also with a practice in Denver was Andrew Larson, a Swedish immigrant who was graduated from the University of Illinois in one of the first classes taught by Stanley H. White. He came to Denver to work for DeBoer. When he opened his own office later he could never get contractors to build exactly the way he wanted, especially stone work. In desperation he started landscape contracting. A.S.L.A. had strict rules against membership if you provided more than design services. Years later he refused to join when invited because he was still angry about this rule. He worked very hard to further the profession in Colorado. To honor him the first board of registration assigned him Colorado Certificate Number 2, S. R. DeBoer having Number 1.

Colorado Numbers Increase

In the 1970-71 membership roster of the A.S.L.A. there are seven firms and 43 members and associates listed for the Denver area. In the current roster, 1979-80 published by the Colorado Chapter of A.S.L.A. there are 28 firms and 194 members and associates from all over the state who pay dues.

The list of plans in McCrary's index to his archives showed the gamut of practice of a typical successful office. It included plans and sketches for the Development Plan for the University of Denver campus, residence for A. T.

McClintock, Brighton Factory, for Great Western Sugar Company, a residence for John C. Mitchell in 1916, Colorado State Industrial School in 1919, San Jacinto Park, Amarillo, Texas, zoning regulations for Pagosa Springs, a subdivision at Grand Lake in 1943, a

housing project, Delmar Gardens, in Aurora, and the Crestmoor subdivision.

The definition of landscape architecture as the art of designing land and placing the components on it for human use and enjoyment is being carried to the highest level of design management by Denver firms. They are now winning contracts as the prime design-professional hiring architectural and engineering firms, planners, and economists to carry out large projects such as major recreation development for recreation agencies, new towns, and major re-development projects in our cities. Also in Denver the governmental agencies such as Bureau of Land Management (B.L.M.), State Highway department, U.S. Forest Service, and State Parks and Recreation now have landscape architects on their teams. The National Park Service Regional Design office in Denver currently is the largest single employer.

No longer is it a necessity to go east for an education in the profession. Colorado State University offers an undergraduate curriculum and the University of Colorado at Denver offers graduate study.

Landscape Architecture is very alive and well. It has matured as a new profession out of a very old art.

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Exotics of Colorado

Chinese Chestnut *Xanthoceras sorbifolia*

Helen Marsh Zeiner

Public parks and cemeteries are good places to see unusual trees and shrubs. For example, *Xanthoceras*, *Xanthoceras sorbifolia* Bunge., also known as Chinese chestnut or yellow horn, is a rare shrub in Denver but has been growing in Washington Park for many years.

To see *Xanthoceras*, go to the southwest part of Washington Park. *Xanthoceras* is growing between the perimeter drive and South Downing Street, quite close to the drive. The planting consists of two large much branched shrubs growing together and forming an almost globose leafy top above the bare branches. It is easily identified. These shrubs have been growing in this location since sometime before 1946, an indication that *Xanthoceras* should do well in other locations in this area.

Xanthoceras is classed as a large shrub or small tree, growing to a height of about 15 feet. It is planted as an ornamental both for its showy white flowers and

its dark green shiny foliage which stays bright and attractive until frost.

The alternate compound leaves are odd-pinnate with rather narrow serrate leaflets. They are dark glossy green above, lighter green beneath.

Flowers are borne in terminal or axillary upright racemes. They are white, but each petal has a blotch at the base which changes from yellow to red. Individual flowers are about 3/4 of an inch across. There are five petals and five sepals. Blooms usually appear in May with the leaves.

The racemes are interesting in that they are polygamous. The upper flowers of the terminal racemes are pistillate, the lower staminate. Flowers of the lateral racemes are mostly staminate, with sometimes a few pistillate ones at the apex.

Fruits are formed by early summer. They are greenish, and in size and general appearance remind one of the buckeye.

Technically the fruit is a capsule with thick walls dehiscent into three valves. Each fruit contains a number of globose dark brown seeds about half an inch across.

Dr. Helen Marsh Zeiner is a regular contributor to *The Green Thumb*. She is a retired Professor of Botany from University of Denver and the honorary curator of the Denver Botanic Gardens Herbarium.



Xanthoceras sorbifolia

Xanthoceras comes from two Greek words: *xanthos*, yellow, and *keras*, horn, alluding to the yellow horn-like processes of the floral disk. These can be seen by picking an individual flower apart. They are suberect, cylindric, and about half as long as the stamens. They are located between the petals and the stamens. Each flower contains four of these horn-like processes and eight stamens.

Xanthoceras is a genus of a single species from north China. It has been under cultivation for a long time and was mentioned in European horticultural literature as early as 1872. It belongs to the family Sapindaceae, the soapberry family.

Not many people are acquainted with *Xanthoceras*, but it is definitely worth knowing. By its habit of growth it is well-suited for solitary planting on the lawn. It needs sun and likes good loamy soil, although it is not too particular as to soil. The length of time this shrub has persisted

in Washington Park is an indication that once established it should be long-lived and satisfactory for the Denver area.

Another ornamental belonging to Sapindaceae and seen in Denver with increasing frequency is *Koelreuteria paniculata* Laxm., the golden rain tree or varnish tree. It is grown for its handsome foliage, beautiful sprays of yellow flowers, and clusters of bladder-like fruits.

If you are a lover of Chinese foods, you are probably acquainted with litchi nuts. The so-called litchi nuts are actually drupes (fleshy one-seeded fruits) and not nuts. The flesh of the drupe is eaten fresh, preserved, or dried and is considered a delicacy. The tree which bears these delectable fruits is *Litchi chinensis* Sonn., another member of the family Sapindaceae. A native of China, the tree is widely cultivated in the tropics for its fruits.

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Oriental Vegetables

John Brett

People who grow vegetable gardens do so for a variety of reasons. Some have small salad gardens to provide a few fresh greens for the evening salad. Others have larger, more varied gardens, perhaps in an attempt to defray some of their food costs or to grow vegetables not readily available at the grocery. Among most gardens there are certain vegetables to be found in common. Radishes, beans, greens of one sort or another, and peas are regular contributions to vegetable gardens.

Such is the case in most parts of the world. Root crops, salad and cooking greens, and one or more legumes are to be found in gardens in many countries and cultures. Many of these vegetables are quite different from what we consider as usual, while others may be quite similar but with a different form.

Vegetables from diverse, world-wide sources have been available to interested gardeners who were willing to research their locations. In the last few years, though, as gardening has become ever more popular (and important) in the American lifestyle, major seed companies have begun to place more emphasis on "alternative"

vegetables. The biggest interest is in the Chinese or Oriental vegetables. Fifteen years ago many gardeners would not have known of edible pod peas; now everyone knows about snow peas or Chinese pea pods. 83

Planting some of these new (to our gardens!) vegetables not only adds variety to the garden and diet but can be an educational adventure — educational not only in the sense of new foods but also their preparation and in some cases their cultural needs. Many of these vegetables can be grown in Denver gardens, most with no more difficulty than those familiar varieties already grown. Some, though, require a little extra care and planning to bring them to fruition. Gardening with new and unique vegetables can be both fun and challenging and always ought to be a learning process.

Following are brief descriptions of several readily available Chinese vegetables that can be successfully grown in Denver area gardens.

Snow peas, Ho Lon Dow, (*Pisum sativum* var. *macrocarpon* Ser.)

These are by all means the most common, well known, and popular of the various Oriental (Chinese) vegetables. The factor

John Brett for several years has been in charge of the Community Garden program at Denver Botanic Gardens. He has written other articles for *The Green Thumb*.

that distinguishes these from ordinary out of the pod garden peas is the absence of the stiff parchment membrane lining the pod, thereby allowing the entire pod to be eaten.

Peas were probably domesticated in central Asia and spread from there most likely as field peas, (dry peas), with development of the sweet, fresh, eating pea coming later in various world locations.

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Growing snow peas is not much different from that of garden peas. Best results will be had when grown in rich well drained soil, though they will tolerate less than optimum conditions. The one condition not to neglect is ample water. Plant them as soon

in the spring as the soil can be worked. The traditional pea planting day is Saint Patrick's day but I have planted as early as March 1st and as late as late April with good success. Harvest the little gems when the peas are just beginning to swell in the pod. They are most delectable at this time, but may be harvested later with good results.

The true joy, of course, of snow peas is in the eating. Try adding a few to a green salad for a special treat. Add them to soups or stews in the last few minutes of cooking, they're best when crispness is retained. Steam them or stir fry them for a few minutes and serve as a vegetable that will receive compliments. For a real treat try stir frying them with mushrooms and fresh or frozen shrimp. Use olive or sesame oil and add a bit of soy sauce at the very end of cooking. Serve with rice or as is and get ready for some good eating.

Chinese cucumber, Kee Chi,
(*Cucumis sativus* L.).

Cucumbers are rapidly gaining in popularity as a garden vegetable and any gardener with a flair for something different would do well to give this interesting and prolific variation a try.

The cucumber was probably domesticated in India as long ago as 6000 years before being introduced into China around 1000 B.C.

The Chinese or Oriental cucumber is the one from which the so called burpless varieties are derived. Most of the Chinese cucumber varieties are long and narrow, some as long as 18 inches.



Chinese cabbage

The traditional method for growing these in the Orient, where land is at a premium, is on a trellis or fence. This is a wise idea here also as these have not been bred down in vine size and may reach 8 feet in length or more. Beyond that, keeping cucumbers off the ground reduces disease problems and in the case of these longer fruits they come off the vine as long straight fruits rather than serpentine oddities. I have had excellent luck planting them inside a tomato cage, training them up the inside and letting them cascade over the top. Plant them when you plant your regular cucumbers in soil that has been enriched with good, rich compost or very well rotted manure. Keep them well watered and if you need to fertilize use a balanced fertilizer (10-10-10) or equivalent in organic materials.

Harvesting can be done at most any size but preferably before they begin to ripen as they deteriorate rapidly at this stage.

The use of these cucumbers is much the same as "regular" cucumbers. Use them in salads and relishes. Make quick pickles; slice thinly and marinate for about an hour in a marinade of 1 cup water, $\frac{1}{2}$ cup cider vinegar, 2 tsps. sugar and a pinch of salt. Drain and serve with a light summer meal. How about cooking them? Sound odd? Go ahead, give it a try! Try lightly sauteing them, after peeling and seeding, with other vegetables, being careful not to overcook them and lose that wonderful crispness, or cook them by themselves adding a few spices or herbs, perhaps ginger, or turmeric.

Chinese Radish, (Japanese daikon), Lo Bok, (*Raphanus sativus* L.).

Here is another vegetable native to the Orient, (probably China). It also has a history of cultivation that is lost in the years of prehistory.

We are used to our small salad variety radishes and may well be surprised at the size of some of the Oriental varieties which can weigh as much as 100 pounds and still be quite edible. I myself have grown them to a prodigious size, (2 feet long, 4 inches across), that when harvested were still just as crisp and tender as a spring radish.

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Chinese radish

There are radishes for spring, summer or fall sowing. The easiest would be to get a spring sown variety, plant at the same time as your regular radishes and harvest about two months later. The fall and winter varieties need cool weather at the end of their growing time so plant them mid to late summer for fall harvest.

86 After harvest, which can be done at any time but before they get too large and woody or flower, is when the interesting part begins. Not only do you have a jumbo version of a vegetable that most people put six of in a sandwich bag but whole new culinary options. Pickled radish is a popular dish in their homeland. Here's one method. 1½-2 lbs. radish, 1 cup sugar, ½ cup white or rice vinegar, 1 cup water and 1¼ cup salt. Peel radish, slice very thinly, place in a non-metal bowl. Combine remaining ingredients in sauce pan. Bring to a boil and cool. Pour over radish, cover, refrigerate 3-4 days. Other options: Grate whole radishes and use as a condiment. Stir fry them with other vegetables, perhaps cucumbers, onion, and garlic, throw in some diced pork and a bit of grated ginger and you've a new taste experience.

Edible Chrysanthemum, Shungiku, (*Chrysanthemum coronarium* L. Garland).

Now, here's a fun one, a true alternative to the usual greens of the garden. When it's past use as a greens crop it flowers, (sure enough, chrysanthemum flowers), which are themselves edible, thus providing a whole new dimension in eating.

Most likely native to the Mediterranean region it long ago

reached the Orient and became an integral part of culture and cuisine.

Growing them couldn't be easier. Their needs are easily met. Plant them in a sunny location on soil that has been enriched with compost or rotted manure. Sow the seed fairly thickly, ¼ inch deep early in the spring. Keep them well watered and don't thin them out too much. When they are about 3-4 inches tall begin harvesting. Individual leaves may be harvested or whole plants if thinning is necessary.

The leaves can be used in quite a variety of ways. Their flavor is distinctive and strong (though not in the hot sense of mustards) and may take some getting used to. Try adding a few leaves, coarsely chopped, to salads or add some to regular greens — beets, chard or spinach.

As with many Oriental foods, chrysanthemum leaves come into their own when stir fried with other vegetables and/or meat. Try them with snow pea pods, mushrooms, water chestnuts and slivers of beef with a bit of soy sauce and saki (rice wine) added for seasoning.

The flowers, too, besides being pretty offer some culinary opportunities. Dip the petals in boiling, salted water and drain on a rack. Serve at the table with small bowls of warmed saki, dipping the petals in the saki before eating. They are also pickled with unique results. Using only the petals, dip in boiling, salted water and drain. Dry well with towels and marinate for an hour in equal parts soy sauce and saki.

Asparagus bean (yard long bean), Dow Gauk, (*Vigna sesquipedalis* (L.) Walp.)

This relative (some claim it may be the same species) of the commonly grown cow pea (black eyed pea) is indeed more closely related to our familiar bean (*Phaseolus* sp.) than to peas. Native to central Africa it was well established in India in Sanskrit times and probably had made it to the Oriental countries by then also. In tropical and subtropical regions this plant grows as a perennial but is often treated as an annual.

This is one vegetable of the Chinese lot that may prove difficult to grow but if you've a spare corner, give it a try. While they are quite tolerant of poor soil and low water they will do much better if given a rich, well drained soil and ample moisture. There is one condition that is absolutely essential for growth of the asparagus bean; warmth. They simply won't tolerate cold soil or temperatures. Plant them a couple of weeks after you plant your regular beans, about the same time that lima beans are planted. One other consideration; these are very vigorous vines so should have adequate support and room to climb.

What to do with them: harvest the pods when still immature, before the beans have really begun to swell inside the pod. The length at this stage will be 12-18 inches. Cut them into one inch pieces and treat them exactly as you would green beans. The flavor is unique and interesting. Another tasty option is to stir fry them in hot oil with garlic and peppers (hot or green)

to the crisp tender stage. If you're a greens fan, plant a few extra poles because the young leaflets make a very tasty pot herb. Pick so as to allow the plant to continue growing.

Bok Choy, (*Brassica chinensis* L.).

This and Chinese cabbage are not quite so well known as snow peas but most people at least have a mental image of what they ought to look like. Both are natives of the Far East and have been cultivated since before recorded history. 87

Bok Choy, also known as mustard cabbage, is a non-heading, upright growing plant that has an appearance that could remind one of green Swiss chard but with a heart similar to that of celery. It comes in a bewildering array of texture and leaf sizes and shapes, each having a specific use.

It may be grown as a spring or fall crop. If grown as a spring crop plant it early (lettuce time) and harvest the entire plant when mature. They won't tolerate single leaf harvesting as it is getting hot when they mature and they may bolt if harassed too much. If planted as a fall crop, direct seeding in late August is the best time as it prefers to mature in cooler weather. Because of the more amenable growing conditions you can often harvest a leaf or few off of several plants for the evening's dinner and still expect good yields later on.

As to use: experiment is the word with these. Because of their relatively mild flavor they blend well with many other vegetables and meat. Perhaps try stir frying

with the white stalk cut into small pieces, cooked until just tender with the leaves thrown in at the very end of cooking. Cook these just until they become wilted. Use the leaves and stalks cut into small pieces in a quiche instead of spinach, or maybe mixed with snow peas and mushrooms with a bit of butter for an interesting change in vegetables.

Chinese cabbage, Pe-tsai, (*Brassica pekinensis* B. Rapa).

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Pe-tsai (white vegetable) is a head forming plant sometimes described as looking like romaine lettuce but considerably larger and not quite so dark green.

There are two main types with many varieties of each. There are tall types which are up to 18 inches tall and 4 inches through.

Michihli is the most commonly available variety of this type.

These are primarily grown for fresh use as their storage capacities are limited.

The other type, the Wong Bok type, are shorter (about 10 inches) and fatter (8 inches) than the Michihli types and will store in a cool cellar or refrigerator for several months. They are best seeded in mid to late July for fall

harvest as seeding or transplants in the spring will often bolt to seed.

Their use is much like that of the other Chinese greens. Use them in salads, either alone or in conjunction with other leafy greens or vegetables. Steam them either by themselves or with other greens or vegetables and serve a vegetable dish. Try this for a quick meal that will excite the palate: To hot oil add $\frac{1}{2}$ tsp. chopped fresh ginger, follow with $\frac{1}{2}$ of a medium onion, 6-10 mushrooms, sliced, a handful of snow peas, fresh or frozen shrimp or pork and sliced cabbage. Cook until all ingredients are tender but crisp. Add $\frac{1}{2}$ cup saki and $\frac{1}{2}$ cup soy sauce and cook 1 minute more. Enjoy over brown rice. Serves 2.

This is but a small sampling of the many exciting vegetables becoming available to American gardeners. If you've grown some of these and would like to grow more or are interested in trying some new and different vegetables, check your favorite catalog to see what they offer; you may be surprised to see what they've tucked into corners and on back pages.



Edible pea pods

Gardening Pre-Historic Style

Rita Shuster

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Southwestern Colorado is an area rich in archaeological sites. From the magnificent Cliff Palace at Mesa Verde to the humble pit houses that lie half-buried under modern pinto bean fields, there are many reminders of the Anasazi people who lived here from 450 - 1300 A.D. It has been estimated that at the peak of their occupation, the population of the area was even higher than it is now.

When visiting these archaeological sites, people often ask how the Anasazi were able to get enough to eat. Because we find baskets of corn, pots of dried beans, and squash stems and rinds in the ruins, we know that the Anasazi were farmers who raised crops to supplement their diet of wild plant foods and game. However, the short growing season and dry climate make agriculture a marginal activity here.

In 1979 I established an experimental garden program near Dolores, Colorado, raising crops similar to those the Anasazi

grew. This work is part of the Dolores Archaeological Program, a major investigation of the archaeological resources in the Dolores River valley that is funded by the Water and Power Resources Service. My goals are to test a variety of crops for their potential to grow in the Dolores area, to describe their growth patterns and requirements, and to experiment with different gardening techniques. With this kind of information we can begin to understand how the prehistoric Anasazi farmers might have produced their food.

I started out by visiting museums in Boulder, Denver, and at Mesa Verde to look at plant remains that have been collected from archaeological sites in Montezuma County. This, combined with reading the reports of early explorers, gave me a picture of the kinds of seeds to use. Many people have asked me if I plant old seeds from the ruins. This is impossible because these seeds have completely lost the ability to germinate after hundreds of years. Instead, it was necessary to acquire fresh seeds, so I began corresponding with scientists who have studied corn, beans, and squash to ask for

Rita Shuster is a graduate student in botany at the University of Colorado, Boulder. She previously spent several years as a horticulturist. The experimental gardens at Dolores are part of her graduate project.

their support. Many sent me seeds which they felt would be appropriate. On a trip to Mexico last fall, I collected seeds from the Tarahumara Indians. Other seed sources include the Southwest Pueblo Indians and commercial seed houses that carry old-fashioned varieties.

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The Anasazi raised several types of corn (*Zea mays* L.) with different sizes and shapes of cobs and different kernel colors and textures. I have chosen blue, yellow, and white flour corns from the Southwest and flint, flour, pop, and sweet corns from Mexico to plant at Dolores. The most common type of bean found in the ruins is the size of a pinto bean and has irregular red spots on a white background. I have these and other types of the common bean (*Phaseolus vulgaris* L.), tepary beans (*P. acutifolius* A. Gray), lima beans (*P. lunatus* L.), and scarlet runner beans (*P. coccineus* L.). Squash and pumpkins (*Cucurbita pepo* L. and *C. mixta* Pang.) are represented in various forms. Other crops include bottle gourds (*Lagenaria siceraria* (Mol.) Standl.), grain amaranths (*Amaranthus hypochondriacus* L.), Indian tobacco (*Nicotiana rustica* L.), Hopi cotton (*Gossypium hirsutum* L.), and devil's claw (*Proboscidea parviflora* Wooton & Standley).

The average frost-free season in Dolores is only 95 days, and the night time temperature can drop into the 40's all summer long. Rain comes as scattered afternoon thunderstorms and can total up to 3" during the growing season. Last year, however, the frost-free season was only 87

days and there was less than 1" of rain from June to September.

Two Plots Cultivated

Two plots were available for experimental gardens. The upland garden, at 7240 feet, slopes gently to the east with a lovely view of the distant LaPlata mountains. The floodplain garden, at 6800 feet, is separated from the Dolores River only by a willow thicket. Both gardens are approximately one-half acre in area and I planted the same crops in each to allow comparison of crop growth and yield in relation to soil type, soil moisture, and microclimate. No prehistoric fields have been identified in the Dolores area and observations on the relative success at the upland and floodplain gardens may provide a clue as to which area would have been utilized by the Anasazi.

Neither site had been cultivated for over fifteen years so I arranged with a local farmer to plow and work the soil in preparation for planting. After this initial cultivation, I have done all further work by hand. The Anasazi might have used a sharpened digging stick, but I use a shovel, rake, and hoe! I planted seeds of corn, beans, and squash at the time of the last frost in late spring, digging holes or trenches where each hill or row was located in order to place the seeds where soil moisture levels were higher. Then I watered each hole with river water and planted the seeds. As the plants grew, I gradually filled in the holes, piling soil up around the roots and lower stems.

Throughout the course of the growing season, I maintained the garden by regularly cultivating the soil, pulling weeds, and trying to keep out predators. Surprisingly few annual weeds such as pigweed (*Amaranthus* sp.), sunflowers (*Helianthus* sp.), or portulaca (*Portulaca oleracea* L.), came up the first year. The perennial lupines (*Lupinus* sp), thistles (*Cirsium* sp.), dogbane (*Apocynum* sp.) and bindweed (*Convolvus arvensis* L.) were very persistent and sprouted anew each week despite my efforts. Skunks, coyotes, deer, and crows were all present as predators but did little harm. Rabbits were more troublesome and repeatedly attacked my beans. Wandering cattle from a neighbor's ranch were the worst pest of all!

It was exciting to watch as one after another crop came into bloom and then began to produce fruits, even in such a cool dry summer as we had last year. At harvest time, I gathered boxes of corn, a pile of squash, dozens of devil's claws, and a generous

supply of tobacco. This first season's work confirmed that it is possible to grow crops to maturity here and allowed a tentative estimate of their yield. I began to think that if I could do this on my first try, the Anasazi with their generations of experience should have been able to do quite well.

Old Fashioned Plants Varied

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The old-fashioned varieties showed a much greater morphological variability than do modern crops. Hopi blue corn produced ears on stalks that ranged from 2 to 8 feet tall. This corn also produced several basal tillers per plant if sown at low densities, giving the plants a bushy appearance. The tillers produced ears smaller than those on the main stalks.

The tepary beans showed a remarkable vigor and recovered from rabbit predation by putting out successive flushes of new



Field of corn



Hopi blue maize

growth. I have heard that they recover from drought in the same way, dying back and then sprouting again after a rain.

The pumpkins (*Cucurbita pepo*) recovered from the first frost in fall and grew several more weeks by producing many new branches along the stem where the original leaves had frozen off. This continued growth allowed more fruits to ripen.

Of all the crops, the Hopi cotton was the most sensitive to short growing season, cool temperatures, and dry soil. Although it bloomed at the end of summer, no mature bolls formed. This cotton was grown prehistorically at Canyon de Chelly and other locations in northern Arizona and northern New Mexico, but those sites are lower in latitude and altitude than Dolores.

The Indian tobacco surprised me the most with its vigor and productivity. The leaves are very high in nicotine and produce unusual sensations when smoked, but they have an alternate use as an insecticide!

Results Compared

A comparison of the results under different treatments showed different factors to be important at different stages in the plant's life cycle. For example, seeds of all varieties of corn, beans, and squash required the additional moisture provided by irrigation in order to germinate, but after the plants were established and growing, additional water produced no advantage. In an experiment with Hopi blue flour corn, the corn watered weekly grew no taller than the unwatered control. Perhaps this is because both groups had such well developed root systems that they were drawing primarily from deep soil moisture reserves, and the superficial application had little effect. Squash and beans, although dependent on added water for the first few weeks of growth, soon developed adequate root systems to survive without further irrigation.

Early planting is important to enable the young plants to take advantage of moisture reserves in the soil, but the days required for germination depends on soil temperatures, with late planted crops starting to grow much more quickly than early planted crops. Thus an interaction of factors makes interpretation more difficult.

After one year, it is too early to compare the overall advantages of the upland versus the floodplain sites, but some points are becoming clear. Soil moisture is greater in the floodplain, but there are more weeds competing with the crops there. Also, the floodplain is in a cold air drainage and has cooler mornings and evenings than the

upland site. Perhaps the significance of these differences will be more clear after a few years' work.

Working with these old-fashioned crop varieties and using simple techniques has given me a better understanding of the life style of the prehistoric Anasazi farmers and their families. As the garden project is continued in years to come, I believe that it can make a great contribution to our knowledge of these people who lived here so long ago.

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Nicotiana flowers

Editors' Note: Mrs. Pandora Wilson, who wrote "Is There A Drip In Your Future?" for the Summer issue of *The Green Thumb* has asked us to list the following items (which she omitted) to the list of references for her article:

"Drip Irrigation" by Kobe Shoji

"History of Drip Irrigation", and "Components of the Drip System" by Agrifim Irrigation, Inc.

Diagram of Drip System by Submatic Irrigation Systems, Inc.



Tobacco plants

Staff Appointments Made in June

Two members were added to the professional staff at the Denver Botanic Gardens in June, 1980. They were Mr. Panayoti Peter Callas and Mr. Kay Kawahara. Mr. Callas will serve as Curator of the Alpine and Rock Garden. The title of Mr. Kawahara's position will be Specialist in the Japanese Garden.

Mr. Callas, who is currently the president of the Rocky Mountain Chapter of the American Rock Garden Society is well known in the Denver Metropolitan area for his interest in and his knowledge of rock gardens. He has been a public school teacher and has been on the staff at Colorado State University, as well as having a wide variety of work experiences.

Mr. Kawahara was born in Japan, but has lived in Denver for many years. He is married and has two daughters. For many years he ran a small independent business in Denver. He is very active in the programs of the Bonsai Club of Denver, where his knowledge and skill have made him highly regarded by many of the people interested in Bonsai.

The two new men face somewhat different responsibilities in the near future. Mr. Kawahara will be working in a garden in which much of the primary planting has been done. Mr. Callas is doing much of the planting in the Alpine and Rock Garden. Both men have been interested in and have helped with the planning of the two gardens.

William H. Anderson, Jr.



Progress — Alpine and Rock Garden

Dr. Gambill Retires

When Dr. William G. Gambill Jr. retired as Director of the Denver Botanic Gardens on July 31, 1980, he had completed ten years of service. Dr. Gambill came to the Denver Botanic Gardens after a successful career as teacher and professor in high school, college, and university, and a period of service with the U.S. Armed Forces during World War II. The years between 1952 and 1970 were spent at Ohio University where he was professor and head of the department of botany.

Dr. Gambill's career at Denver Botanic Gardens has been achieved at a time when great expansion of the plant was taking place. He arrived at the time of the 1970 Development Fund Drive which was successfully carried through to completion. Funds obtained from this drive enabled the Trustees to authorize construction of the last major portion of the central physical plant. A special grant from the Boettcher Foundation made possible the construction of the Education Building, as well as preliminary work at Chatfield Arboretum. Included in the structure of the education building are the facilities for the Helen Fowler Library, the Kathryn Kalmbach Herbarium, Horticulture Hall (now John C. Mitchell Hall), and meeting and classrooms.

A second Fund Drive in 1977-78 produced more than \$1,750,000 in donations and pledges. This money has made possible, generally speaking, the construction of the Japanese Garden and Tea House, the Alpine and

Rock Garden, the Orchid-Bromeliad House, as well as some work at the Chatfield Arboretum, and in some of the other special gardens within the Botanic Gardens area.

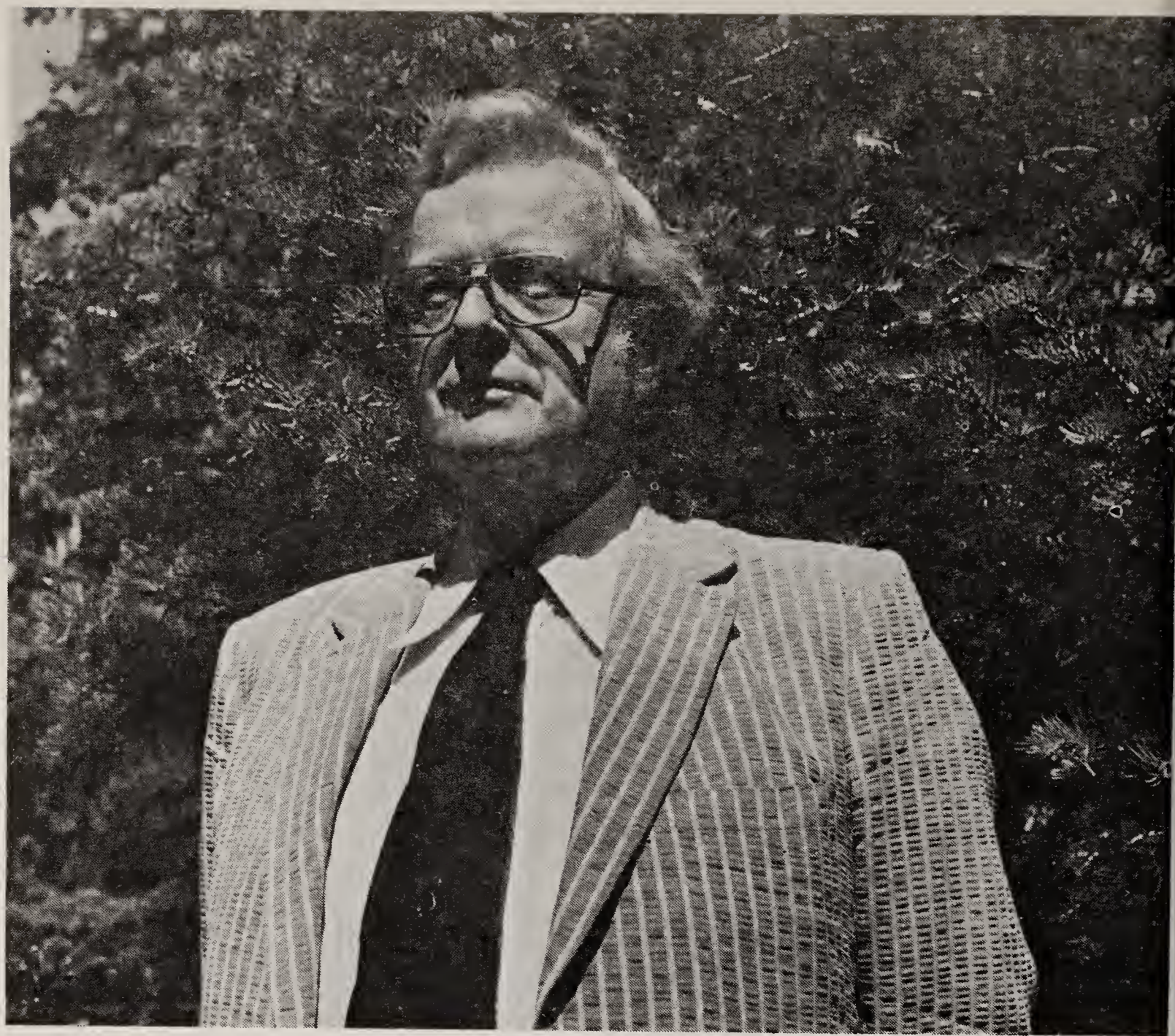
In the planning of these structures and garden areas, Dr. Gambill's training and experience have been extremely valuable to the members of the Board of Trustees, and to the various and numerous volunteer committee members working in the interests of the Denver Botanic Gardens.

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He has served as botanic leader for several of the overseas trips sponsored by the Gardens. His articles on specialized botanical subjects have appeared in professional publications. He compiled two sets of laboratory exercises used in first and second semesters of a one-year course in general biology at Ohio University. Several articles written by Dr. Gambill have appeared in the pages of *The Green Thumb* over the past ten years.

Taxonomy was Dr. Gambill's major field in his graduate work. In his letter to the President and members of the Board of Trustees requesting retirement Dr. Gambill wrote:

"I am, by this letter, giving notification of my intention to retire as Director of the Denver Botanic Gardens as of 1 August 1980. It is my sincere desire to serve the Gardens, after my retirement, in a professional capacity as a



William G. Gambill, Jr. Ph.D.

botanist. With the approval of the Board of Trustees, and after a suitable interval, I should like to have an opportunity to do work in the Kathryn Kalmbach Herbarium, to teach classes, to lead field trips and become immersed in the taxonomy of the native and cultivated flowering plants of the plains and front range areas of Colorado. If time and energy permit it is my intention, also, to be helpful in furthering the development of certain of the unfinished gardens at the York Street location, particularly the Japanese and Plains Gardens, and also the Chatfield Arboretum. If in any of these capacities the Board of Trustees believes I may be useful,

I humbly offer my services."

At the meeting of the Board of Trustees at which Dr. Gambill's letter was received the Board passed the following resolution which was unanimously accepted:

"The Board of Trustees approves Dr. Gambill's request for retirement with our statement of approval for his past ten years of faithful service, and furthermore, I include in the motion our approval of his promotion to the rank of Director Emeritus and that he be awarded certain amenities to be determined by the Executive Committee."

William H. Anderson, Jr.

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Chanoyu

Japanese Tea Ceremony

Kim D. Thrasher

98 *Chanoyu*, the Japanese Tea Ceremony as we refer to it in English, is one of the many deep-rooted disciplinary art forms of the mystical East. Because the world of tea encompasses most of the significant Oriental disciplines, *Chanoyu*, more so than any other art form provides a well-rounded insight into Japan, her people, and her tradition. In the late 16th century, Sen Rikyu and his followers put the finishing touches on the form which became *Chado*, the "Way of Tea", and this form has remained even to today uniquely Japanese. As is the case with most of the Eastern disciplines however, one's Japanese-ness or lack of it is of no real significance, and is in fact irrelevant, for the spirit of tea is the spirit of man and therefore ultimately universal.

Historically, one must begin at the beginning, and for *Chanoyu* this means 5th century China, where tea, then recognized as a medicine, was used in Buddhist temples in a ritual in which the

head priest served the monks during periods of meditation. Naturally, as a part of the Buddhist tradition, this ceremony became known to the Japanese with the introduction of Buddhism. However, it was not until 1191, when Eisai returned from his studies in China to introduce Zen to Japan, that the Japanese had first-hand knowledge of the tea plant and its cultivation. Eisai was the first in Japan to report the many physical and spiritual benefits of tea-drinking. That tea is good for the body cannot be argued for it is known that tea leaves contain many valuable vitamins and minerals. Eisai expounds this theory in part of a book in two volumes where he explains that health is simply a balance within the system and goes far enough to state that tea-drinking helps to maintain this balance and enables one to live a fuller life by providing longevity. Eisai is responsible not only for initiating the close relationship between tea and Zen, but also for their rapid widespread popularity in Japan.

Mr. Thrasher has been a student of the Urasenke School of Chanoyu for eight years. After completing nearly four years of study at the Urasenke School in Kyoto, Japan under the direction of Mr. Soshitsu, 15th generation descendant of Sen Rikyu, he has returned to Denver to share with all interested persons the "Way of Tea".

The development of *Chanoyu* received very little in the way of historical contributions during the next two hundred years. Not having been indigenous to Japan, the tea plant was slow in developing. Many plantations

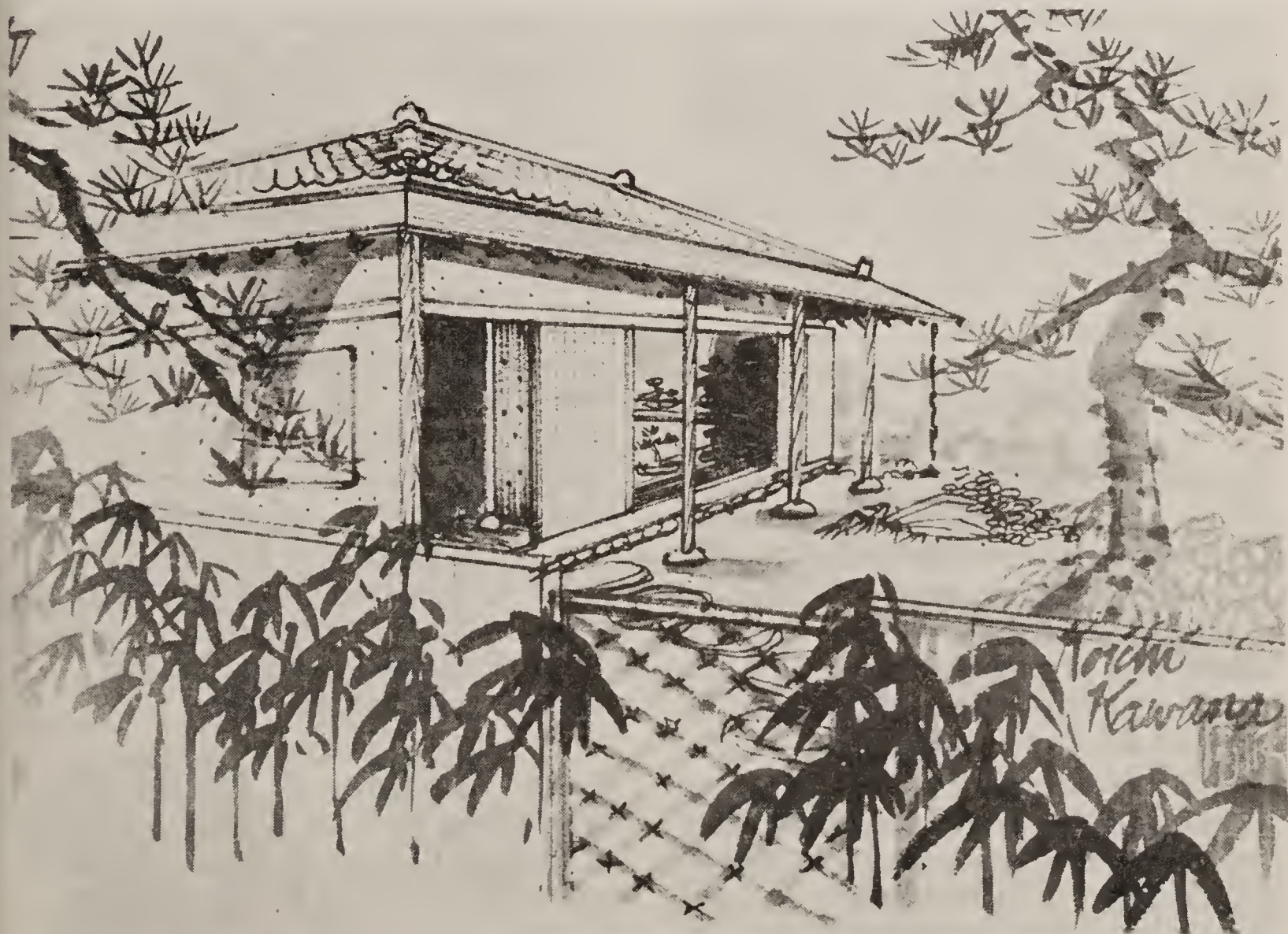
appeared throughout Japan during this period, a few of which remain even to today as producers of the finest quality tea. The question of quality, strange as it may seem, was responsible for a relatively stagnant period of nearly two centuries in the historical development of *Chanoyu* for it brought about the advent of "tea-tasting parties". These parties or gatherings were held by wealthy lords and nobles, and provided great entertainment for their guests as they entered into contests whereby fine silks and bronzes were gambled on one's ability to discern one tea from another and finally to select from several teas that which was the "true tea" or "original tea" which was that tea grown from seeds sown by Eisai himself in the 12th century. A decree was passed by the Ashikaga Shogun in the late

15th century banning all such gatherings, labeling them as degrading and demoralizing affairs.

Being of a romantic yet subdued nature, the eighth in the rule of the Ashikaga Shoguns, Yoshimasa, commissioned Murata Shuko, a highly accomplished Zen priest, to reform the tea ceremony encouraging him to introduce Zen ideals and sensitivity into the practice. Shuko died in 1502, having scarcely begun this endeavor, yet having succeeded in establishing forever the practice and discipline of *Chanoyu* as a way.

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Shuko's pursuit along this path was later taken up by Sen Rikyu, who at the age of seventeen proved to be the most insightful and sensitive tea master in Japan's history. In his later years, Rikyu was employed as tea



The Japanese Tea House

master by Toyotomi Hideyoshi, the ruling Shogun of the time and one of Japan's single most significant historical figures. At Hideyoshi's encouragement, Rikyu, with a deep Zen background and understanding, devised *Chado*, the Way of Tea, by following to the end that road begun by Shuko.

100 One's purpose in following a way or path is self-realization. The basis for the Eastern disciplines is that self-discipline is the first step towards self-realization and Zen, as a discipline, is no exception to the rule. Rikyu employed his sensitivity to the ideals of Zen in the creation of the form of *Chanoyu*. Zen holds as its ideals those things which are both uncomplicated and unaffected, that is, those things which are simple, thus its intimate relationship with nature. Zen is not confined by attachments or restricted by the passions. Rikyu, emphasizing this Zen philosophy of simplicity and the naturalness of all things, established four principles as the basic fundamentals for any tea gathering.

Four Fundamentals

As regards harmony, the first of these four principles, Rikyu began by eliminating all things unnecessary. When one's life is cluttered with adornments, unnecessary attachments and unessentials, the simplification needed for harmony's existence cannot be found. Rikyu simplified, wherever possible, the tea ceremony in order to achieve this harmony. He rid the occasion of extravagances in utensils as he displayed a deep

preference for simple, natural, and even imperfect objects as opposed to the luxurious imported celadons, porcelains, and bronzes, previously used. Superficial politenesses as received and expected by the status quo were also done away with by Rikyu in his efforts to create harmony physically and spiritually, for as he said, "in the tearoom, there are but host, guest, and tea." The ease of handling complementary utensils and pleasantness to the eye of color and texture blend, along with nature's soothing sounds and quiet fragrances are essentials in the harmony of the tea world.

Respect, the second of Rikyu's principles is evident of its own accord with little or no external pressures applied. To be in attendance at a full formal tea gathering is an overwhelming experience. As a guest, one is the recipient of the most sincere and basic forms of human sharing. To witness it, is to appreciate the painstaking efforts of the host towards creating through the ceremony, the perfect moment of sharing, for Rikyu's goal in the practice of *Chanoyu* is found in that which is the theme central to any tea gathering, "one time, one meeting". We have, on the occasion of a tea gathering, only that moment together, in all space and time. All efforts of host and guest are to make that moment perfect. Only the respect, or in fact reverence, of one individual for another makes such a moment possible.

Purity, the third of Rikyu's four principles, can be found in every aspect of *Chanoyu*. In a physical sense cleanliness is mandatory for the success of any tea gathering. The utensils, the garden, the

room, one's attire, and everything else about the gathering reflect this concept of cleanliness.

Though each of the utensils has been cleaned prior to the gathering, a host's opening moves in any ceremony are to clean again before his guests, the utensils to be used. Within the form and discipline of *Chanoyu*, these moves are performed rhythmically, allowing the host not only to purify the utensils, but in so doing to purify himself, so that when the tea is prepared in pure utensils, it is served from the honesty and purity of the host's innermost being.

The fourth and final basic principle of Rikyu's *Chado* practice is tranquility. Guests usually three to five in number, are invited to a tea ceremony and are greeted at the entry gate to the host's home by a clean freshly watered garden path, the purity of which immediately conjures up images of a fresh spring rain on a mountain side covered with lush greenery. After taking a leisurely stroll along the path through the garden to the main waiting room where the guests' preparations are made and greetings exchanged, the guests follow another stone walkway to the roji or dewy path which is the garden surrounding the tea-house. This tea garden is void of any bright colors or fragrances and resembles the natural landscaping of the mountains or valleys with some greenery, stones, and perhaps a babbling brook. In the center of the garden is a waiting arbor where all the guests assemble for a few moments of meditative silence in the peace and serenity of the surroundings.

When the host's final prepara-

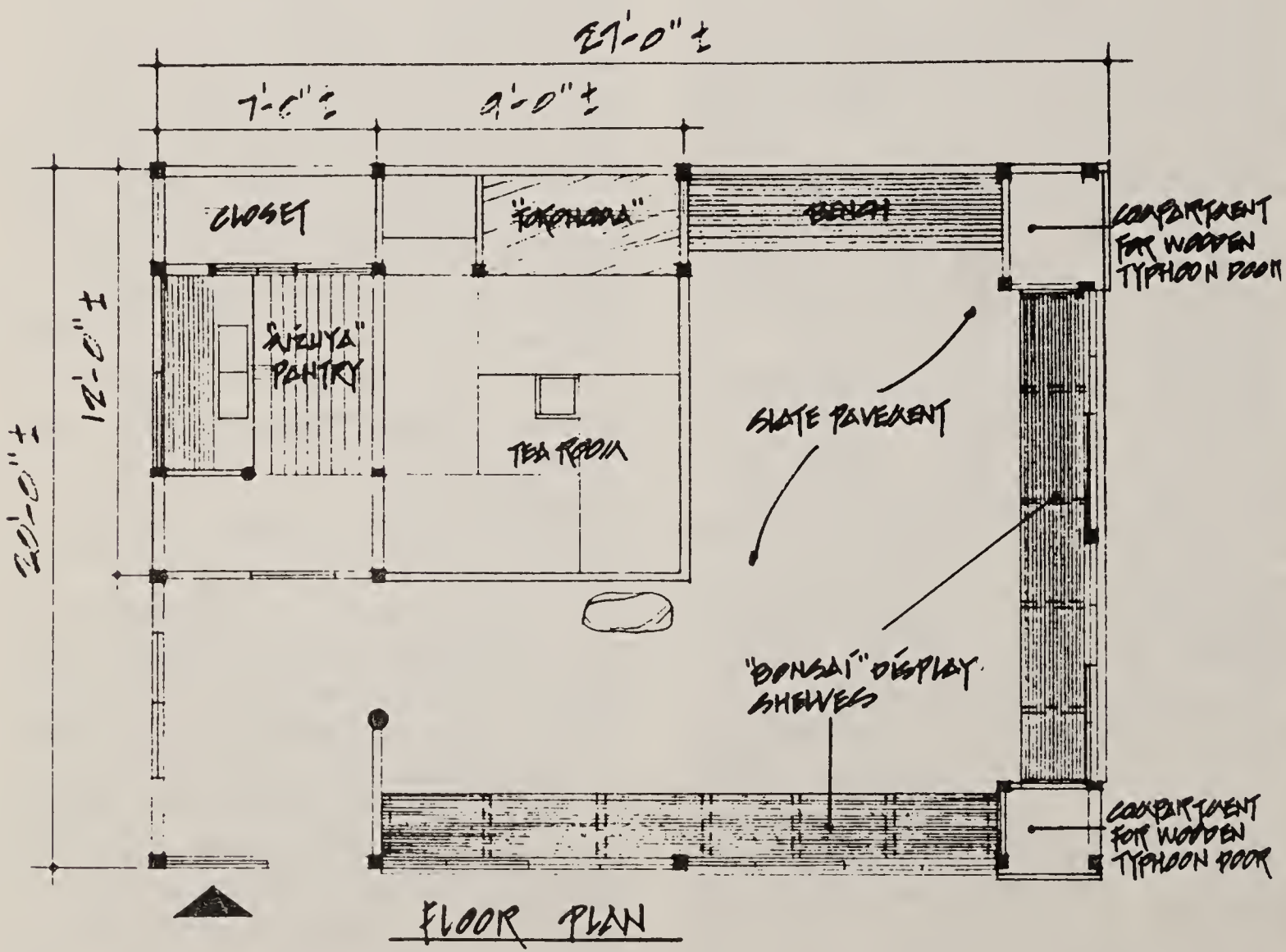
tions are completed, he goes out into the garden to greet his guests and invite them to join him in the tearoom. The host and guests will stop along the path at a stone water basin to rinse their hands and mouths in a symbolic gesture of purification rinsing away the "dust of the world". Each of the guests following the host will then enter the tearoom through a small entranceway roughly three feet square. One is literally forced to crawl on hands and knees, for to humble oneself is to realize the lack of significance of social status or wealth and to recognize the importance of the inner being. When the guests are comfortably situated in the room, the host serves a light meal consisting of the finest samples of seasonal vegetables, fishes, and soups. The serving of the meal is followed by a ceremony for the laying of a charcoal fire for heating the water for tea. This one and a half hour first half of the formal tea gathering comes to a close after the guests have been served a rich cake-like sweet and have moved out to the garden again for a brief intermission. During this break the host cleans up the room and places a simple flower arrangement in the recessed alcove, removing the hanging scroll enjoyed by the guests during the first sitting. 101

Again the guests are invited to the room following the same procedures as before and are immediately served thick tea, the first of two kinds of tea. This sharing of thick tea is the climax of any tea gathering. Everything is directed towards creating the perfect atmosphere for the sharing of this bowl of tea. The meal is served, charcoal laid, flowers arranged, scroll hung, and

utensils arranged all to create a harmony among all individuals concerned through the rigorous discipline and consequent self-realization or inner harmony, a respect brought about by the giving and receiving of basic human love and sharing and the realization that one is to revere as well as be revered, a purity where each person in the room has shed away ego, superficialities and false appearances to the degree that all persons in the room are equal, and a tranquility which is the peace and serenity of the sum of all of the parts of any tea gathering. When one drinks from the bowl of prepared thick tea, all worldly concerns vanish and one tastes the "liquor of life", for in that bowl of tea are the ingredients of the most

basic sharing of human love — a love communicated through that disciplinary form which encouraged its own discovery. The fire is rebuilt, a lighter sweet served and thin tea shared between the host and guests as the full tea gathering comes to a close.

The host and his guests having shared this experience of a tea ceremony have shared much more. Seemingly nothing more than a social gathering of friends, the Way of Tea provides for all participants a moment of introspection, a motive and means for the manifestation of that which is revealed, and an intimate sharing of the essence of the human spirit.



Teahouse Floor Plan

Photoperiodism and Plant Flowering

Stephen P. Berg

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There is a marvelous progressive synchrony of flowers which parades through our flower and vegetable gardens each year. In the spring we see our forsythia, lilacs, and columbine. Summer brings zinnias, marigolds, and carnations, and fall is synonymous with chrysanthemums. However, the purpose of this report is not to catalogue or document the splendid display, since many of the readers could do this far better than I. The purpose is rather to probe the questions of why this synchrony occurs, and at much greater length how the plants can synchronize their flowering as well as they do.

With regard to why plant blooming is synchronized, it is only important to recall that: 1) for any species to survive, the individuals of that species must reproduce themselves by producing offspring; 2) the flower is the fundamental piece of reproductive hardware in the plant,

and 3) many plants require cross-pollination for subsequent seed production. Thus, if flowering were not synchronized and individuals flowered randomly during the growing season the likelihood of successful cross-pollination would be drastically diminished and it would be more unlikely that the species would survive.

So, if synchronized flowering is so important, how do the individuals of a given species manage to accomplish this feat? For most plants, the answer is that the individuals have the ability to measure the length of relative periods of light and dark which occur on a daily basis. Plant physiologists call this ability photoperiodism. Besides flowering, we now know that photoperiodism synchronizes a number of physiological events including leaf fall, development of frost resistance, dormancy, formation of storage organs, stem elongation, and leaf growth.

The importance of daylength in controlling flowering was discovered by two scientists associated with the United States Department of Agriculture about 60 years ago. Wightman W. Garner and Henry A. Allard were

Dr. Steven P. Berg is an assistant professor in the Department of Biological Sciences at the University of Denver where he teaches Plant Physiology and does research for the United States Department of Agriculture in the area of photosynthesis.

trying to improve tobacco (*Nicotiana tabacum* L.) production when they came across a mutant strain of the plant which produced huge leaves and grew much taller than the parent cultivar. This mutant plant had obvious commercial value but Garner and Allard were dismayed when fall approached and there was still no sign of flowers on the giant plants. So the plants were moved from the field into the greenhouse for frost protection. Finally in early winter the plants produced flowers and seeds which bred true. These seeds produced the Maryland Mammoth strain of tobacco.

To determine what caused the late blooming of this strain, Garner and Allard did many experiments with controlled light and dark periods, temperatures, nutrients, and moisture. From these studies they determined that Maryland Mammoth tobacco would flower only if exposed to days which were shorter than a critical length. Similarly they found that some varieties of soybean (*Glycine max* C. L. Merrill), cosmos (*Cosmos bipinnatus* Cav.) and ragweed (*Ambrosia artemisiifolia* Bess.) also flowered only when exposed to days which were shorter than some critical length. Each species had its own unique critical length, but the species were similar in that the light periods required for flowering had to be shorter than the critical length. These plants were called short day plants (SDP).

Garner and Allard also learned that other plants such as spinach (*Spinacea oleracea* L.), radish (*Raphanus sativus* L.), and lettuce (*Lactuca sativa* L. cv. Black Seeded Simpson) remained vegetative when exposed to short

days but flowered when exposed to days longer than a critical length. They called these plants long day plants (LDP).

Finally Garner and Allard noted that some plants flowered when they reached a certain age or developmental state, regardless of the length of the day. These plants were termed day-neutral plants (DNP). Some examples are cucumber (*Cucumis sativus* L.), dollar plant (*Lunaria annua* L.), globe amaranth (*Gomphrina globosa* L.), sunflower (*Helianthus tuberosus* L.) and most tobacco (*Nicotiana tabacum*).

Once Garner and Allard had clarified the role of light in the flowering response, botanists and plant physiologists could begin to answer a number of questions which had been previously unexplainable. Why are ragweed (*Ambrosia artemisiifolia*) and cocklebur (*Xanthium strumarium* Ell, Sketch, Bigel, Fl., Bost) not found growing north of Winnipeg? The answer is related to the fact that both species are SDP. Ragweed will not start to produce buds until the days are shorter than about 14.5 hours. Cocklebur requires days shorter than 15 hours. In Winnipeg the days do not become this short until mid-August and so there is simply not enough time to produce buds, flower, and set viable seed before the first frosts kill the plants. In Denver where the summer days are shorter, both plants receive permissible photoperiods in mid to late July and there is ample time to produce seeds before the first killing frosts in late September.

Similarly, we might ask why many LDP such as white

mustard (*Sinapis alba* L.) can't be naturalized into tropical climates? The answer is again related to the plant's photoperiodism. White mustard requires days longer than about 14 hours before it will flower. In the tropics the days are 12 hours long the year around and so the mustard never flowers or sets seed. Hence it will not grow in the wild.

Unfortunately, photoperiodism is not quite as straightforward as it might seem from the above discussion. Before most plants can respond to their correct photoperiod they must reach a certain developmental stage which has been termed "ripeness to flower." For example, in the spring, when very young chrysanthemum (SDP) (*Chrysanthemum morifolium* X) plants are exposed to days shorter than the critical length the plant fails to flower. At the end of the summer when the plant is mature and "ripe to flower" the flowering begins as soon as the days are again shorter than the critical length.

To further complicate the matter, photoperiodism in plants is usually dependent on other conditions such as temperature, number of inductive cycles, and cultivar. For instance, the poinsettia (*Euphorbia pulcherrima* Willd.) and the morning glory (*Ipomoea purpurea* (L.) Roth.) are SDP at high temperatures and LDP at low temperatures. So if you have tried to get your poinsettia to bloom for Christmas and failed, you might blame your lack of success on temperature.

Throughout this discussion we have talked about daylength as determining the flowering

response. But we have not answered the question of how plants measure the length of the day. The answer is found in the biochemistry of the plant. All plants contain a biochemical substance (a protein) called phytochrome. Phytochrome can exist to two slightly different forms which are different in color and which can be interconverted. One form, called P660, is inactive. P 660 is quickly converted by light to the active form 105 called P730. In the dark, P730 spontaneously but very slowly converts back to the P660 form. This conversion is so slow that very long nights are necessary to convert all the P730 into the inactive P660 form. In SDP the P730 is very active at inhibiting flowering. Even a small amount of P730 will completely prevent the flowering response. Thus, unless the nights are long enough to allow all the P730 to be converted to P660, flowering will not begin. In LDP, the situation is not as clear, but in essence, the P730 weakly stimulates flowering. The stimulation is not sufficient to produce flowers until the days reach some critical length.

Clearly, photoperiodism in plants is a complex phenomenon. And, as you might imagine, it is actually far more complex than we have been able to discuss here. But we can understand that it is important for all plants of the same species to bloom at the same time to insure reproductive success. And we can understand that plants measure daylight by using a protein called phytochrome which can either inhibit or stimulate the flowering response depending on the particular plant species. And finally, we can know that even

for a single plant it becomes meaningless to talk about the critical photoperiod unless we also stipulate the age of the

plant, the temperature, and a variety of other environmental conditions.

TABLE I:

Some Short Day, Long Day, and Day-Neutral Plants. In addition to the correct number of the appropriate photoperiods, specific temperatures, and/or vernalization may be required. More complete lists are available from Vince-Prue, 1975; Salisbury, 1963, or Bidwell, 1974.

SHORT DAY PLANTS

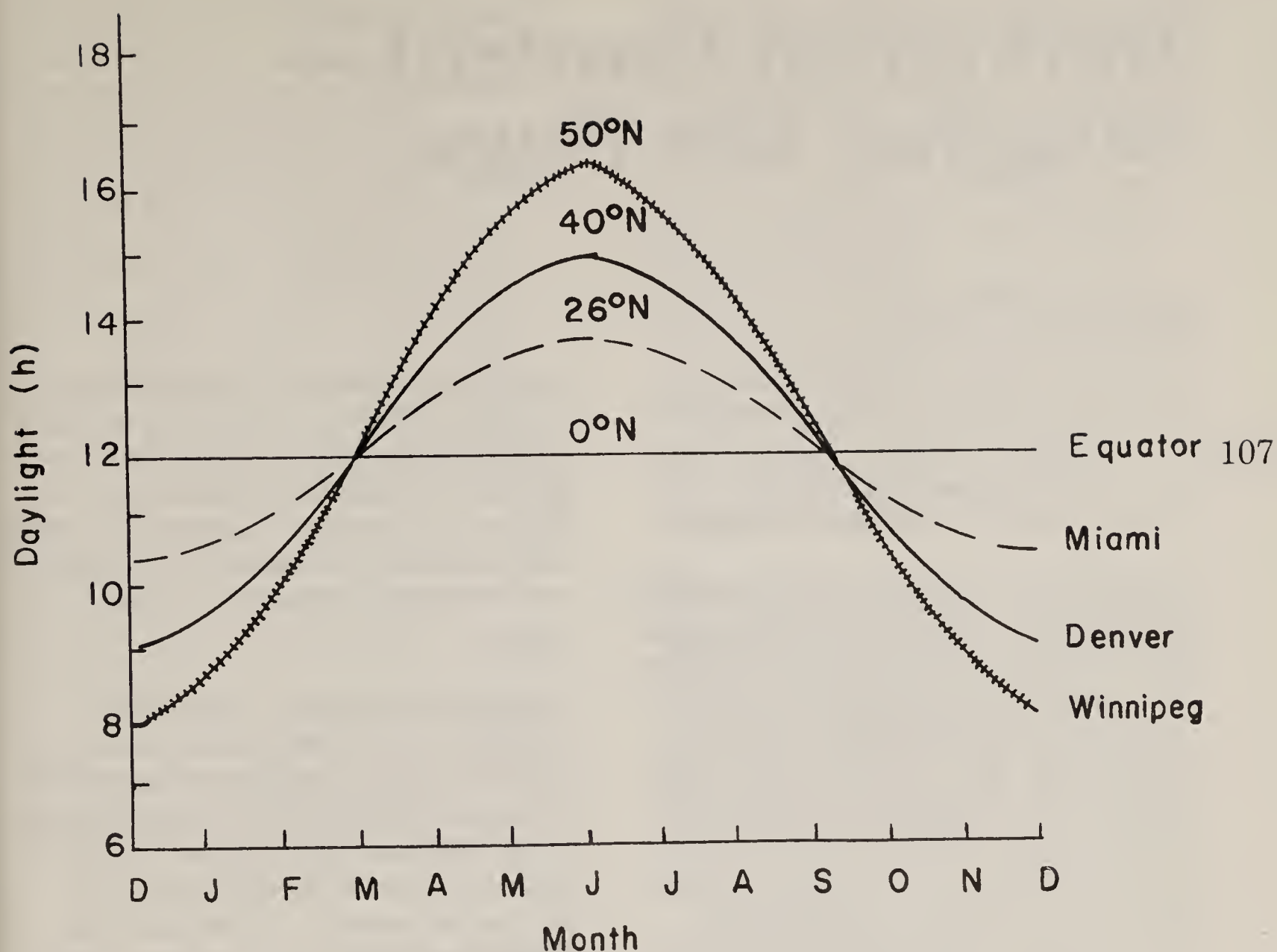
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- Bryphyllum (*Bryophyllum pinnatum*)
 - Chrysanthemum (*Chrysanthemum* spp.)
 - Cosmos (*Cosmos sulphureus*)
 - Duckweed (*Lemna paucicostata*)
 - Japanese morning glory (*Pharbitus nil*)
 - Kalanchoe (*Kalanchoe blossfeldiana*)
 - Morning glory (*Ipomoea purpurea*)
 - Orchid (*Cattleya trianae*)
 - Perilla (*Perilla crispa*)
 - Poinsettia (*Euphorbia pulcherrima*)
 - Rice (*Oryza sativa* cv *Zuiho*)
 - Tobacco (*Nicotiana tabacum* cv Maryland Mammoth)
 - Violet (*Viola papilionacea*)

LONG DAY PLANTS

- Barley (*Hordeum vulgare*)
- Black-eyed Susan (*Rudbeckia hirta*)
- Beet (*Beta vulgaris*)
- Cabbage (*Brassica* spp)
- Coneflower (*Rudbeckia bicolor*)
- Fuchsia (*Fuchsia hybrida* cv Lord Bryon)
- Hibiscus (*Hibiscus syriacus*)
- Petunia (*Petunia* spp)
- Stone crop (*Sedum spectabile*)
- Sweetwilliam silene (*Silene armeria*)

DAY-NEUTRAL PLANTS

- Amaranth (*Gomphrina globosa*)
- Balsam (*Impatiens balsamina*)
- Bean (*Phaseolus vulgaris*)
- Carrot (*Daucus carota*)
- Corn (*Zea mays*)
- Dollar Plant (*Lunaria annua*)
- Holly (*Ilex aquifolium*)
- Jerusalem artichoke (*Helianthus tuberosus*)
- Potato (*Solanum tuberosum*)
- Sunflower (*Helianthus annuus*)
- Rice (*Oryza sativa*)
- Tobacco (*Nicotiana tabacum*)



The hours of daylight available throughout the year at several northern latitudes and at the equator. Note that as the latitude becomes more northerly the summer days become progressively longer until at the pole, the days are 24 hours in duration. This figure has been extensively modified from Noggle and Fritz, 1976.

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Nicotiana sp.

Biological Control — Bugging the Bugs

Andrew Pierce

108 Many of you will have read in *The Green Thumb Newsletter* of our "Bug-In" in the Conservatory, but with such a topic more information should be available.

Biological Control in the ecological sense can be defined as the regulation by natural enemies of another organism's population density to a lower average than would otherwise occur. More simply this could perhaps be termed as applied ecology. Man for a considerable time has been aware of natural controls though it was not until the late 18th century that applied insect controls were really put into use. One has to go even further back to note that the ancient Chinese fostered an Ant, *Oecophylla smaragdina*, in their citrus trees to control caterpillars and large boring beetles. Such practice continues today. Similar development was applied in Arabia on the date palm where predatory ants were carried down from the mountains and spread in the palm groves. The earliest recorded transference of a natural enemy from one country to another took place in the 1760s when the Mynah bird was taken from India to Mauritius to control red locust. From this

point on more work was carried out, principally in Europe, and the recognition of such controls quickly spread to Japan and China. A major influence here was the problem of disease of the silk worm and its spread by other insects.

People's knowledge expanded rapidly in the 1800s and such notables as Louis Pasteur and Dr. Erasmus Darwin, the grandfather of the celebrated Charles, had their influence. Weed control, by the use of insects, dates back to 1863. Since then very many types of biological control have been put into practice principally on the important economic crops of the world such as grains, cotton, palms, and citrus.

My introduction to biological control was in a more obnoxious way during my stay in Bermuda where a very large toad, *Bufo marinus*, that was introduced from Surinam in 1975, took control of the infestations of roaches. A major disaster in Bermuda saw the extensive destruction of the native cedar (*Juniperus bermudiana* L.) forest by scale insects and even though biological controls were introduced they were unfortunately too few, too late. More recently young cedars are making a comeback and it is again significant to note that their protective parasites are still present. This illustrates perhaps

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one of the big fundamental differences between biological control and chemicals — they persist and continue their work, becoming obsolete only when man’s chemicals kill them or their hosts vanish. From the foregoing it can be seen that biological control occurs in many forms such as birds, toads, insects, mites, and even fungus. Most people think only of insects controlling other insects and in their minds often conjure up battles between friend and foe. Often biological control is much more subtle than this though the instance of a Praying Mantid ripping apart insects nearly as large as itself is perfectly true. If one were to ask which biological control do you know the Lady Beetle would be first mentioned and this indeed is a very adept killer of Aphids. Others will opt for the Praying

Mantid but few realize that the Green Lacewing, we often see dead in our lampshades, is another beneficial predator attacking Aphids in abundance. In practice much of our control comes in the form of very minute wasps and even smaller mites, and while I will dwell further on our introductions later the subject is so vast that one should use the references at the conclusion of this article.

The Pros and Cons on Introductions

Generally economics of commercial crop production and viability of marketable product is governed by its cleanliness and appearance when it reaches the consumer’s shelf. This in the main, perhaps unfortunately, is controlled by the use of chemicals but in the long

Comparison of Types of Control

The Problem	Chemical Usage	Biological Control
Pollution, hazard to man and wildlife	Considerable	None
Persistence in soil	Can be long term	None
Creates unbalance in nature	Frequently	Does not
Length of control period	Temporary even with repeated applications	Permanent if hosts are available
Resistance buildup	Frequently	Almost never
Range of control	Most insects but secondary build-up occurs rapidly	Could be all but in practice only some
Economic application costs of purchase	High/Very high	Moderate/low
Cleanliness	High grade	Tolerable

term is somewhat short-sighted. This has been particularly emphasized by the large scale inability, regardless of the amount of pesticide applied, to produce an economic cotton crop over much of the southern states acreage.

Biological control may not produce a perfectly clean crop, as to have an active situation you require both host and predator or parasite to be present.

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At this point integrated pest management or the pest management concepts should be clarified as it is here that applied scientific use of pesticides combines with ecological practices. Pesticides are used only as a last resort along with biological control and then only at a defined stage of a pest's life cycle. In this way economic crops can be produced without the stigma of total chemical control. Much more has been done in this area even to the extent of a feasible control of street tree pests in Berkeley, California with a minimal use of synthetic chemicals. Surprisingly, plain water sprays have played their part as a wash-off process rather than using another chemical.

People are not positively aware of the naturally occurring controls happening in the world at any given time; they are many more and far more diverse than nearly

all could ever imagine. Man's delving into nature's practices is perhaps of minor consequence when using biological controls but if one considers plant life as a whole in the world of forest, grassland, and even desert it continues to grow with its own natural balance. It is only when man reaches for the chemical that drastic unbalance occurs. Crop production by its own element is an upset to this balance and yet we continue to grow and modify the world without always considering the consequences.

The Conservatory and Its Bug-In.

Moving to things on a much, much smaller scale and in the light of current pesticide procedures and problems of their application, Denver Botanic Gardens has revamped its spraying operations. We have now established biological control in the Conservatory. This is a stage further forward than integrated pest management though we do perhaps visualize the use of a very specific chemical on a pest insect, at the correct killing stage, if it becomes necessary in the distant future. The controlling of some of the present pest populations is being done by introduced predators which literally devour their hosts. Other types are parasites who lay their eggs in or



ENCARSIA

attacking Aphid

The First Summer: Planting the Rock/Alpine Garden

Panayoti Callas

What greater proof is needed of the old adage that "a garden is never finished" than the natural rock gardens of the Colorado Rockies? Here, the tundra and fluctuating timberline are both ever changing. Few long-time residents of the state have escaped the embarrassment of taking visitors to this or that flowery vale they remember ("The columbines are thick as grass up there") only to find the spot snowed in still, somehow changed, or simply paved over.

In the matter of four months, the Rock/Alpine Garden at the Denver Botanic Gardens has progressed from a sea of weeds to an area thickly planted with thousands of alpine and wild plants from every corner of the temperate world, comprising thus far some fifteen hundred species. Many more will sneak in to join their ranks before winter sets in. Bare ground is quickly disappearing in this garden, and by next spring one can expect to see broad ranks of alpine pinks in countless forms and species, dozens of sorts of columbines cascading down this or that slope, and quite a number of

respectably sized buns and alpine cushions covered with flowers no less exuberantly than at higher altitudes. The garden is suddenly filled, but by no means is it finished. 113

The whole story behind the planting of this garden would require a volume, not an article. It would be impossible to name the dozens of volunteers who spent days in clearing the various beds of weeds and preparing the ground for plants. A few will be mentioned in the course of this article — those who have spent many weeks of their time in bringing this garden into being — but many more will have to rest content with the knowledge that the largest collection of alpine plants in the Rocky Mountain region came about through their sustained efforts.

Aside from Sandra Snyder and me from the Denver Botanic Gardens staff, three volunteers have seen this garden through the planting stage: Evelyn Murrow has brought years of horticultural expertise to this garden; Paul Maslin has contributed not only hundreds of cuttings and thousands of seedlings, but every Wednesday he brings the wit, charm, and wisdom of one of America's greatest rock gardeners; Betty Woolums has

The Green Thumb has published a number of articles by Panayoti Callas who is a dedicated rock gardener. He is now Curator of the Rock/Alpine Garden at the Denver Botanic Gardens.

brought the eye of an artist and great energy to the Rock/Alpine Garden.

With their help, and the indefatigable crews of Associates of the D.B.G. organized by Virginia Faxon, the planting beds were cleared of a jungle growth of weeds and painstakingly planted and maintained. Alpine plants rarely flourish when they are ripped from their native turf. We do not wish to encourage this practice, and since the cost of furnishing this garden from purchased plants would have been astronomical, the task of producing plant material for the garden fell on the already busy hands of the DBG's Propagation Unit. Andrew Pierce, Superintendent of the Conservatory and Greenhouses, displayed a remarkable knowledge of alpine plants. He selected hundreds of species of saxifrage, primrose, gentian, dianthus, rock jasmine, and other choice alpine seed from the seed-lists of botanic gardens worldwide. As a result, this garden will feature many plants which will bloom in America for the first time next spring. Richard Schimming, Chief Propagator of the Gardens, had the novel task of coaxing thousands of recalcitrant alpiners into growth. Judging from the results, one would be tempted to think that alpiners in Denver possess the vigor of marigolds.

Despite their lofty origin, despite the third hottest summer in Colorado history, hailstorms, trampling, and novelty, the plants that emerged from the Propagation Unit have thrived with hardly a plant being lost in the shuffle.

Many plants had been started in 1979 and wintered in frames their

first winter. Most of these bloomed in the course of 1980. Many garden visitors were impressed with the throngs of wild columbines in dozens of species which bloomed this year in the garden: *Aquilegia saximontana* Rydb. & Robins. which in nature is entirely restricted to tundra of the front ranges of the Colorado Rockies, bloomed at this low elevation with a vigor never seen in the scruffy timberline plants. The lurid, mahogany-colored *Aquilegia ecalcarata* Maxim. from China proved surprisingly luxuriant. There were many other healthy plants, a mass of clematis-flowered columbine (*Aquilegia caerulea* James var. *daileyae* Eastw.), the rare mutant of our state flower, and two delightful dwarf red and yellow columbines: *A. shockleyi* Eastw. from the Sierra Nevada and *A. elegantula* Greene from our own Western Slope were both especially lovely this year.



Aquilegia sp.

near the hosts and then the larvae eat them. At times both types of beneficial insects go into dormancy or pupa stage and their activity is not always visible. Some are also extremely small, such as those that prey on the Red Spider Mite, and once they are released it is extremely difficult to catch and monitor them again.

Our first introductions included the following predators:

Cryptolemus montrouzieri Beetles to attack Mealy Bug and Brown Scale.

Amblyseius californicus, *Phytoseius persimilis*, and *Metaseius occidentalis* Mites to prey on Red Spider Mite.

These will be followed with *Crysopa carnea* or Lacewings and *Apihius testacipes* to try and control the aphid problem. We have still another Scale to combat as the *Cryptolemus* does not appear to be working on it. In most instances the biological controls are extremely selective in their choice of hosts and are active only against a specific pest. An exception to this is *Cryptolemus* which attacks both Mealy Bug and Brown Scale. Since the introduction of our predatory friends considerable control of Mealy Bug has taken place. At one stage there were so many predators about that people frequently told us our conservatory was full of 'pests'. Additionally these 'Crypts' sojourned on top and at the tips of leaves whereas the Mealy Bugs hide beneath the leaves and between the petiole and the stem. Consequently, the "Crypts" were indeed more visible and no one could fail to see the large masses of white predators who look very much like Mealy Bugs. Though not actually observed, due to their

extremely small size, more minute than the point at the end of this sentence, the Red Spider Mite predators appear to be doing their job as the leaves at the top of the palm trees are greener! Along with beneficial aspects we are definitely noticing a build-up of another type of scale, which will have to be identified and acted upon. At the time of writing it is centered in the southwest corner on various types of plants and it may not spread too far due to its many immobile stages. Unbeknown to us we have been extremely fortunate to have had what appears to be a natural control of White Fly taking place. We have not observed any parasites or predators but what was once one of our most visible and prolific pests in the conservatory is now becoming hard to find. Nothing is static in the world of insects and changes take place constantly. Traditionally White Fly has been controlled biologically by a parasitic wasp, *Encarsia formosa*, and I can recollect helping release these very small wasps in England a quarter of a century ago.

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Tolerable Levels Sought

We are after only tolerable levels with both host and predator and parasite being present, not after complete elimination. If this took place no doubt nature would soon get its own back! The economic savings on our own small operation are considerable. In the past we could spend \$400 on materials and labor for one spraying, and here we are using a grant of \$1000 from Colorado Horticulture Research Institute for perhaps 18 months or 2 years control. This will still leave positive results in the form of left over generations of predators. More significantly the potential hazard to the pesticide

applier and to the public will have been eliminated.

Good use can be made of forceful water washing of plants, to leaf break point, but it must be remembered that your biological pesticides such as Pyrethrum and Nicotine as a back-up in the application of integrated pest management can be considered as a last resort. Alternatively *Bacillus thurgiensis*, a bactericide going under the names of Dipel or 112 Thuricide, can be effective in controlling caterpillars should they be present in numbers too large to hand pick. *Rodale's Color Handbook of Garden Insects* is perhaps the first comprehensive control book, with exceptional identifying colored plates, put out with the avoidance of pesticides in mind.

There are more ways than you think of controlling so called pests and biological control is but one that can be used on a limited scale. In the home garden because of climatic conditions and the fact that the predators and parasites can fly off to no-man's land, the practice of integrated pest management will prove much more practical. I for one sprayed only twice during the past season, with *Bacillus thurgiensis* or Thuricide, in a very mixed garden

including a vegetable patch. While not eliminating all pests I certainly come out on top in production.

Biological control is practical in certain given situations providing you are not after absolute perfection — even with chemicals that seldom occurs. When coupled with integrated pest management many a garden can be a happier, healthier place for both people and beneficial insects to live in. Given the current trend of chemical use and exploitation there is only one way to go.

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PRAYING MANTID

$\times \frac{2}{3}$

Most of us know the rather strange calceolarias that florists will feature in greenhouses in the winter months. These plump, slipper flowers or pocketbook plants possess a number of hardy relatives which proved to be highlights in the garden this year. The confusing rabble of *Calceolaria biflora* Lam., *C. falklandica* Kranzl. and *C. polyrrhiza* Cav. from Patagonia and the Falkland Islands are graceful perennials that produce a constant succession of dazzling yellow slippers over a neat, deep-green rosette of foliage from May well into July. These calceolarias apparently hybridize considerably in cultivation, for the different species had a similar appearance and all prospered in a variety of soils and aspects in the garden, surviving our winters with no damage.

The silenes have furnished the garden with many fine plants. This genus is best known for the alpine moss pink and many sticky catchflies, but *Silene keiskei* Miq. from alpine heights in Japan is a first rate garden plant, blossoming most of the summer with a mass of bright pink stars over a low mound of foliage. *Silene virginica* L. from the eastern woodlands strikes every garden visitor with its many, intense scarlet stars. *Silene schafta* C. C. Gmel. from the eastern European Alps highlighted the latter part of summer, smothering its low mounds with countless pink blossoms.

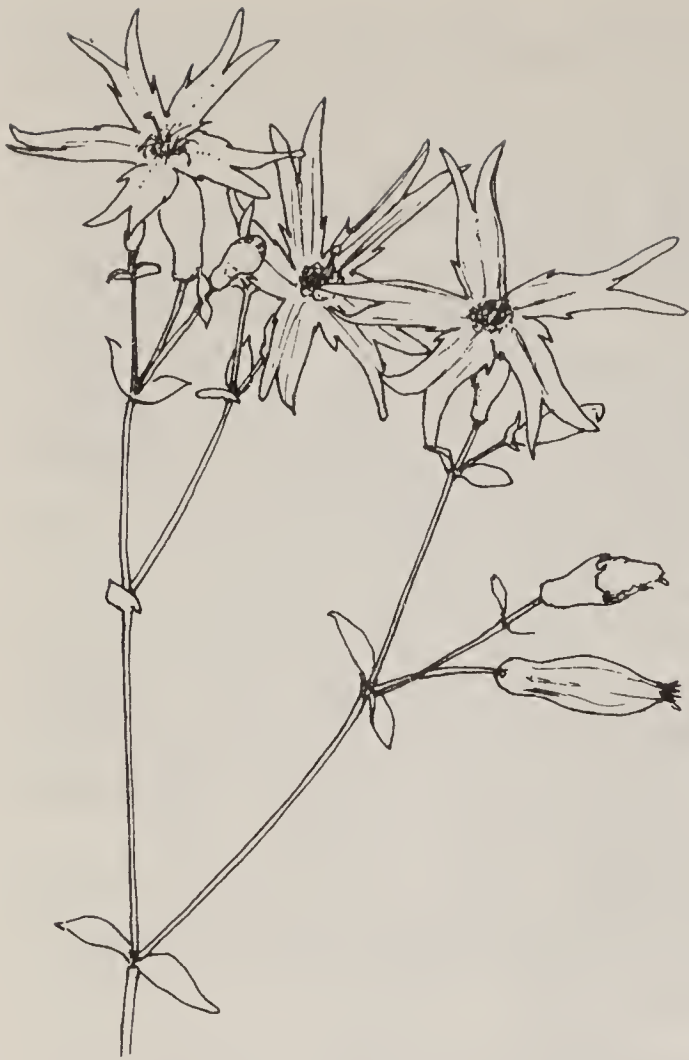
Dozens of other choice alpenes bloomed well the first year in the garden: *Campanula cochlearifolia* Lam. in a number of distinct color forms was especially noteworthy. This is the famous fairy thimbles of the Alps, producing an end-

lessly ramifying mat of glossy, prostrate leaves and masses of bright lavender, white, and violet bells on two or three inch stems for most of the summer months. Fairy thimbles have produced a solid mat of many square yards along the west base of the Scree Mound in one summer. A number of distinctive genera related to campanulas have done remarkably well this first year: stocky white *Symphandras* from the western Mediterranean, seven species of alpine *Phyteumas* from Europe, central Asian *Codonopsis* with their skunky odor and intricate bells, *Laurentia*, *Jasione*, and *Adenophora* were also represented with many species each.

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Unquestionably the choicest plants to grace the garden this summer were the various relatives of *Phlox nana* Nutt. which Paul and Mary Maslin have introduced to cultivation from the mountains of Chihuahua, Mexico. The yellow phlox that graces many slopes in the garden has produced a constant succession of bloom from June to frost. This taxon (whose scientific name is still in question) is blooming for the first time in a public garden. The orange and scarlet phlox are not only new to horticulture, but new to science as well. The full story of this group of plants is still unfolding and will be told more fully in another article in the future.

The success of these and many other plants is largely due to the care and forethought Herb Schaal employed in designing and constructing the garden. The engineering of the garden is such that any excess moisture is quickly drained away. The tremendous range of soil types and rocky outcrops provides myriad microenvironments that can



Silene virginica

sustain the highest alpenes from wet mountain ranges — such as the inch tall *Rhododendron radicans* Balf.f. & Forr. from the Himalayas, and yet other slopes can hold healthy agaves from the desert ranges of New Mexico or Utah. Schaal described the dozens of carefully prepared soil mixtures and programmed watering regimes he employed in the garden in an earlier article in *The Green Thumb*. I will briefly recapitulate how the planting has followed the original scheme.

A steep Montane Slope borders the garden to the east as one approaches the entrance to the Rock/Alpine Garden. This slope has been planted with a variety of dwarf mountain maples, larches, and aspen that are so often found in such situations throughout the Northern Hemisphere. This miniature montane slope is underplanted with a thick groundcover of columbines, ferns, woodland

anemones, and wildflowers from many countries throughout the world, emulating a sort of idealized, wet mountain slope. Since this was one of the first areas planted in the garden, the plants have attained a large size and should bloom well this coming year. Many of the trees on this slope were purchased and brought back from the Northwest by Allan R. Taylor, a professor at the University of Colorado in Boulder. Dr. Taylor is an enthusiastic rock gardener with a special interest in hardy cacti, rhododendrons, and unusual trees. We will be anxiously watching the performance of the rare trees and dwarf conifers he selected, since all but a few are growing in Colorado for the first time. Many of the plants he brought back, such as *Camellia x williamsii*, were donated to the DBG for testing by northwestern nurserymen. The results of this expedition are certain to yield many rare and fascinating woody plants for Colorado gardens.

The Montane Slope gradually drops into a thick aspen glade to the south. This healthy grove of aspen will be encouraged to extend in coming years to provide the main woodland garden and Rhododendron Glade of the Rock/Alpine Garden. The path along the Montane Slope curves past a large, established white fir to climb up along the southern mound of the garden which rises to the highest point in the southwest corner of the property. This area is the architectural backbone of the garden. It comprises a Fell Field, which grades into the Boulder Field and the extensive springs that feed the water feature of the garden. This area from Montane Slope to the Summit is comprised entirely of granitic rocks of all sizes, shapes, and textures. More

than any other part of the garden, this area recalls the rock formations found in the higher Front Range, which can be glimpsed along the path through a forest of giant conifers to the west in Cheesman Park.

The planting along this slope is meant to recall the mountains as well: the deciduous Montane Slope passes through a miniature conifer forest which in turn gives way to an imitation *krumholz* of dwarf conifers and alpine plants along the Fell Field and Boulder Fields.

The peaty soil mix, modified here and there with gravel and sand, allows a wide variety of true alpiners to be grown here. The arctic gentian has established well here from seed collected on Mount Evans. Many ericaceous plants, so prevalent in wetter alpine tundra, have been established along the North Ledge, just north of this steep path. *Erica*, *Calluna*, *Cassiope*, *Bruckenthalia*, *Menziesia*, *Vaccinium*, *Phyllodoce*, *Pieris*, *Leucothoe*, and *Andromeda* are just a few of the euphonius generic names of plants that are growing lustily on this slope. Although people despair of growing ericaceous plants in Colorado, they will find that many will thrive provided they have a moist, acid soil and cool roots. The North Ledge provides an optimal environment for many of these, and their companion plants such as Asiatic *Primulas*, *Epimediums*, and choice dwarf conifers such as the hemlocks. This area is also well along in growth, having been one of the first to be cleared of weeds.

The long North Slope brackets the water feature of the garden. A series of bubbling springs rises on top of this slope and cascades

down a remarkable seepage area that provides an excellent micro-environment for moisture loving ferns and primroses. An alpine stream flows from this seepage through the three central planting areas of the garden: the Limestone Cliffs to the west next to the Alpine House, the Alpine Meadows to the north and the Moraine Bed and Scree Bed to the east.

The Limestone Cliffs consist of limey scree of a high pH that is optimal for growing lime-loving alpiners and Mediterranean plants. A variety of campanulas and alpine geraniums are among the cascading plants that have been nestled in these cliffs. The keynote of this area is grey foliage: dozens of white leafed plants including tiny, large flowered mulleins,

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Cassiope sp.

salvias, euryops, and saxifrages can be found in the Limestone Cliffs. Thymus and pussytoes have been planted in the flagstone path that dissects the Cliffs. Mediterranean plants comprise an important element in the classic Rock Garden, and anyone who has visited California's White Mountains, or the lofty desert ranges of the western American Great Basin must realize the importance of xerophytic alpine to the natural environment.

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Many alpine plants insist on root companionship and the drainage this provides for optimal growth. The Alpine Meadow is the area where such plants are best attempted. Although this area was planted only in August (when many people were certain the tiny seedlings would perish from the heat), it has almost completely covered itself with a flowery tangle of brooms, globularias from

the Alps, New Zealand cotulas and acaenas, Eurasian dianthi with a wealth of species of *Ipomopsis* and *Artemisia* from America. A simulated stream winding through this meadow is bordered with a number of different, complementary iris including our native *Iris missouriensis* Nutt., the Alaskan *Iris setosa* Pall. and *Iris biglumis* Vahl. from Central Asia.

The Alpine Meadow rises to a rocky point near the entrance to the garden where a number of shrubby alpine are established to cascade over the rocks including our native *Juniperus communis* L., high mountain manzanitas, and a variety of European alpine brooms (*Genista* and *Cytisus* species).

Across the main pathway through the garden from the Lower Meadow there is a large semi-circular area consisting of the



Rock Garden and Alpine House

native, bentonite clay of the Botanic Gardens. This Upper Meadow will be a testing ground for dryland plants from various deserts and steppes of the world. Helichrysums and acantholimons from Central Asia can compete with New World castillejas, penstemons, artemisias, and yuccas in this rather distasteful soil. This Steppe area should be one of the more novel parts of the garden, where drouth resistant herbs and shrubs can be tested for the ever increasing numbers of dryland gardeners.

The riparian Woodland Garden to the west of the Alpine Meadow is the last large area in the garden to be prepared for planting. This will be worked on during the latter part of 1980 and early 1981 for planting early in the year.

The last two areas that remain to be mentioned are the Scree Bed and the larger, underground-watered Moraine Bed that constitute the centerpieces of the garden. These beds include a tremendous variety of exposures and microenvironments: there is a mix of both granitic and limestone chips in different parts of both beds to cater to the different needs of plants that are grown upon them. These beds include the most characteristic cushion and bun-forming groups of alpine plants: the tiniest alpine dianthi such as *Dianthus alpinus* L. in variety, *D. winteri* L., *D. freynii* Vandas, *D. glacialis* Haenke and many more. Daphnes of many species are growing here with remarkable vigor, along with dozens of alpine drabas from all corners of the globe, rare androsaces from the tiny *Androsace sarmentosa* Wall. and European aretias to the lush Himalayan species such as

Androsace foliosa Duby, *A. strigillosa* Franch., and the improbable *A. rotundifolia* Hardw. which resembles a geranium far more than it does its tiny rosetted cousins. *Dryas integrifolia* Vahl. from Alaska has grown as vigorously as our native mountain avens on this bed, and a number of subspecies of *Papaver (alpinum) nudicaulus* L., the frilly-leaved diminutive alpine poppy, have bloomed continuously here all summer and fall.

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For the botanically minded, the Rock/Alpine Garden should be nothing less than a living herbarium of alpine plants where one can compare our native taxa with their cousins from alpine



Iris sp.

areas throughout the world. Additionally, this garden should test hundreds of potentially valuable plants that could be grown in any garden in Colorado — especially rock gardens at home or for the many Coloradoans who live in mountain communities and despair of what will tolerate their short growing seasons. Most

importantly, I anticipate that this magic setting, so skillfully selected and arranged with elegant boulders, will mature into a lovely garden where unusual plants can grow harmoniously and blend into a landscape that does justice to our native peaks. It will take more than four months to achieve this ambitious end.



Anemone nemorosa

1980 Survey of Annuals and Grasses

Gayle Weinstein

It is well understood that plants respond differently to climate, soils, humidity, and the like. But for many plants we have little reliable information concerning their performance. At the Denver Botanic Gardens annual trial gardens, we attempt to make a comparative study of the performers and the nonperformers. The approach is to record throughout the growing season height, spread, flower color, and quality, disease resistance, design possibilities, and effectiveness. This comparative study in one location is beneficial to those interested in planning bedding displays and gardens. In addition, through this observation process, we may uncover patterns and problems that merit further study.

This year, 221 annuals and orna-

mental grasses were displayed. The different numbers and types of flowers as well as conditions under which they competed are many. In mid-July, besieged by a 30 minute hail storm, many plants made a miraculous recovery and performed better than they had prior to the storm. We are looking for such vigorous and recuperative attributes in addition to continuous, long-lasting blooms. 121

Next year at this time, we will have results of more possibilities in annuals and ornamental grasses. We are planning to try some direct seeding of bedding displays and the use of indoor foliage plants for possible displays.

The following charts summarize this year's observations:

Gayle Weinstein is a Botanist-Horticulturist at Denver Botanic Gardens. This is her first article for *The Green Thumb*.

1980 Charts of Performance

NAME	Height	Spread	Vigor	Flower Color Quality	Foliage Texture	Disease	Design Effect Potential
<i>Agrostis nebulosa</i> Cloud Grass	6"	4"	poor	white, 3	f		try again
<i>Alyssum</i> 'Pink Heather'	6"	8"	good	pink, pale	f		pastel, 2
<i>Alyssum</i> 'Snow Cloth'	6"	12"	good	white	f		good, 2
<i>Anagallis arvensis</i> Shepherd's Clock	8"	5"	poor	deep blue	m		drought tol.
<i>Anchusa</i> 'Blue Angel' (T)	12"	8"	ave.	blue, 2	m		perennial bed

NAME		Height	Spread	Vigor	Flw. Color Quality	Foliage Texture	Disease	Design Effect Potential
122	<i>Avena sterilis</i> Animated Oats (OG)	2'	6"	good	beige	m		drying
	<i>Begonia</i> 'Foremost Pink'	5"	5"	ave.	pink	m		formal, 1
	<i>Begonia</i> 'Foremost Red'	5"	5"	ave.	scarlet	m		formal, 1
	<i>Bromus macrostachys</i> (OG) Brome Grass	1½'	12"	good	tan-grey	m		drying, 2
	<i>Calendula</i> 'Dandy'	18"	12"	ave.	orange, 3	m		cutting, 3
	<i>Calendula</i> 'Family Circle' (T)	2'	12"	ave.	orange-yellow, 1	m		1
	<i>Calliopsis</i> mix	3'	1½'	good	org.-yel.	f		naturalizing
	<i>Capsicum</i> 'Holiday Cheer' (AAS 1979)	4"	3"	poor	red, yel.	m		3
	<i>Capsicum</i> 'Holiday Time' (AAS 1980)	5"	4"	poor	red	m		3
	<i>Celosia</i> many varieties tried	varies		poor	many			poor results on all tried
	<i>Coix lacryma-jobi</i> Job's Tears (OG)	3'	2'	good	green 1	m		hedge, 1
	<i>Coleus</i> Fiji Series			poor	grn, yel. red	m		poor in sun
	<i>Cosmos</i> 'Sensation' series	3'	2'	good	pink, white	f		wild appearing
	<i>Cosmos</i> 'Sunset'	2½'	2'	good	orange 1	f		more refined
	<i>Cuphea</i> 'Firefly'	8"	8"	ave.	scarlet	f		potted plant
	<i>Cuphea</i> Cigar Plant	18"	1½'	good	pink	m		perennial bed
	<i>Eragostis tef</i> (OG) Love Grass	18"	2'	good	whitish 3	f		1 graceful
	<i>Gazania</i> 'Golden Margarita'	8"	8"	ave.	deep yel.	m		hot areas 2
	<i>Geranium</i> 'Bright Eyes'	15"	14"	ave.	red-white eye	c		2
	<i>Gomphrena</i> 'Buddy'	8"	3"	poor	pink 1	m		try again
	<i>Helianthus</i> 'Dwarf Sungold'	18"	14"	good	yellow	c	rust	3
	<i>Helianthus</i> 'Teddy Bear'	2'	14"	good	yellow	c	rust	3
	<i>Helianthus</i> 'Yellow Pigmy'	2'	14"	good	yellow	c	rust	3
	<i>Impatiens</i> 'Blitz' (AAS 1981)	18"	15"	good	scarlet	m		1 for shade
	<i>Kallstroema grandiflora</i> (OG)	15"	2'	good	whitish	f		wild growth
	<i>Layia platyglossa</i> Tidy Tips	8"	5"	poor	yellow	f		3
	<i>Machaeranthera</i> Tahoka Daisy	15"	12"	poor	blue	f	wilt	cutting 3
	Marigold 'Glowing Embers'	10"	8"	good	orange	m	wilt	typical
	Marigold 'Janie' (AAS 1980)	8"	8"	good	orange	m		compact 2
	Marigold 'Sunrise' (T)	15"	10"	good	yellow	m		2

<i>Mesembryanthemum chrstallinum</i>	5"	5"	poor	white	c	3
<i>Mesembryanthemum criniflorum</i>	4"	5"	poor	pink	c	3
<i>Monarda citriodera</i> Lemon Mint	2'	15"	good	blue	m	perennial bed
<i>Oryzopsis hymenoides</i> (OG) Indian Rice Grass	12"	10"	ave.	white	f	1 graceful
<i>Panicum virgatum</i> (OG) Switch Grass	4'	12"	good	purple	f	1 refined naturalizing
<i>Petunia</i> 'Blushing Maid'	15"	15"	good	dbl. pink	m	1
<i>Portulaca</i> 'Afternoon Delight'	8"	10"	good	mix	f	3 closed in afternoon
<i>Portulaca</i> 'Sunglo' Series	8"	10"	good	mix	f	Pink excellent
<i>Portulaca</i> 'Sinkiss' Series	8"	10"	good	mix	f	Not as nice as Sunglo
<i>Rhynchelytrum roseum</i> (OG) (<i>Tricholaena</i>) Ruby Grass	3½'	15"	good	pink 1	f	1 graceful
<i>Tithonia</i> 'Torch'	5½'	2½'	good	orange 1	c	1
<i>Verbena</i> 'Sangria'	14"	15"	good	red 1	m	1 groundcover
<i>Zinnia</i> 'Bouquet Hybrid Orange'	22"	15"	good	orange 1	m	cutting
<i>Zinnia</i> 'Bouquet Hybrid Scarlet'	22"	15"	good	scarlet 1	m	cutting
<i>Zinnia</i> 'Peter Pan Flame' (AAS 1980)	12"	12"	good	scarlet 1	m	1 compact
<i>Zinnia</i> 'Scarlet Ruffles' (T)	18"	15"	good	scarlet 1	m	cutting

AAS = All American Selection
OG = Ornamental Grass
T = Test
1 = Superior
2 = Average
3 = Inferior
F = fine
M = medium
C = coarse

Merle M. Moore is New Director of D.B.G.

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Mr. Merle M. Moore began his duties as the new Director of the Denver Botanic Gardens last month. Mr. Moore was Assistant Director from August 1978 to August 1980 and has been Acting Director since the latter date when the former Director retired. Announcement of his appointment was made by the Board of Directors of Denver Botanic Gardens and Mr. Joe Ciancio, Manager of Parks and Recreation for the City of Denver.

Mr. Moore holds a Bachelor of Science degree in Landscape Horticulture from Michigan State University and has completed a full year of post-graduate study. Before coming to the Denver Botanic Gardens our new Director had been serving as the Senior Horticulturist of the Mathaei Botanical Gardens at the University of Michigan since 1974. Previous to his tour of duty in Michigan he held the position of Assistant Horticulturist at the Holden Arboretum in Mentor, Ohio.

Of special interest is Mr. Moore's experience as an advisor on civilian programs to the Vietnamese Government on the district and province level. His position was with the U.S. Agency for International Development operating out of Washington, D.C. Earlier, as a Peace Corps

volunteer, he served as agricultural advisor for Peace Corps volunteers working with various hill tribes in remote areas of Thailand. Prior to his government service, Mr. Moore spent a period as a managerial trainee at the Wayside Gardens Company in Mentor, Ohio.

He has a long time interest in horticultural therapy and is currently the President of the National Council for Therapy and Rehabilitation through Horticulture.

Since coming to the Denver Botanic Gardens Mr. Moore has been especially interested in the planning of the garden for the handicapped which will be located north of the area long known as the Children's Garden. During his time here he has also been responsible for the growth and propagation of plants in the various gardens as well as designing and developing new gardens.

Mr. Moore's two years as Assistant Director have coincided with a great surge of progress and development at the Denver Botanic Gardens. The Japanese Garden and Tearoom, the Rock/Alpine Garden, and the Margaret E. Honnen Orchid-Bromeliad Pavilion have all materialized during this time, and the new Director has had a share in planning the plantings in all three.



Director Merle M. Moore

Mr. Moore is a member of the American Association of Botanical Gardens and Arboreta, the American Horticultural Society, the Royal Horticultural Society (England), and the Garden Writers Association of America. There are three children in the Moore family.

In announcing the appointment members of the Board of Trustees of the Denver Botanic Gardens called attention to the wide scope of Mr. Moore's experience in Botanic Gardens and in administering programs.

William H. Anderson, Jr.



Earl Sinnamon

Earl Sinnamon was one of the Botanic Gardens longtime best friends. He was, in fact, first a friend of the Gardens' predecessor, the Colorado Forestry and Horticulture Society of which he was a director and a vice-president.

Since the day of his graduation in 1946 from Colorado State University he worked to make Denver beautiful — as supervisor of nurseries for the Denver City Parks, as City Forester in 1947-48, as part of the first (1949) plant auction in Civic Center, as chairman of several subsequent plant auctions. These auctions grew into today's highly successful Annual Botanic Gardens Plant Sale. For many years Earl gave very special attention to the trees surrounding Botanic Gardens House.

After he joined Swingle Tree Surgeons in 1950 he contributed not only his own expertise to make Denver beautiful but often volunteered company time, talent, and equipment to further Denver horticulture. As owner of the company since 1956 and as president of Swingle, Inc. since its incorporation in 1964 until his death in July of this year, he invested a life-time toward making Denver a nicer place to live. *The Denver Post* published on July 25th the letter of tribute to Earl Sinnamon reproduced below.

"A TIRELESS WORKER FOR LIVING THINGS"

To The Denver Post:

"The city of Denver recently lost one of its most tireless workers, a man who spent hours of his own time in the past 34 years (aside from his professional life) in keeping Denver beautiful."

"*The Denver Post* in its issue of Wednesday, July 16, published a succinct obituary of Earl Sinnamon. What wasn't said was that his personal interest in, and love for, growing things virtually outweighed his professional interest. Many of us can attest to the number of times, when a horticultural disaster seemed imminent, we would hastily call Earl and he would respond, in person, as rapidly as a busy schedule would permit."

"One friend said of him, 'I really think Earl knew every tree in my garden' — something I'm certain could be said of every garden he ever served in Denver."

"Earl devoted a great deal of his volunteer time to projects for the Park People, Botanic Gardens, and was tireless in making the grounds of St. Johns Episcopal Cathedral what they are today.

"His interests and knowledge were such that Denver is more beautiful for his having been here.

"When we 'Think Trees', we should for many years think Earl Sinnamon."

Connie Burwell White

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